Compressed Air Magazine

MARCH 1947

DORMANT MINES IN SCENIC AREA

View in Colorado's San Juan Mountains between Ouray and Silverton.

(Photo, Russell G. Knight)

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Compressed Air Magazine

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EDITORIAL CONTENTS

ADVERTISING INDEX

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ON THE COVER

HIGHWAY 550 links Ouray and Silverton, Colo., both illustrious names in the state's mining history. Leaving Ouray, the road shuttles back and forth to gain height, then threads its way southward along a wall of Uncompahgre Canyon and on a shelf blasted out of solid rock. Approaching its high point, it passes through less rugged terrain, then begins its descent to Silverton. The thoroughfare is called the "Million-Dollar Highway" because it cost that much money in an era when such a sum was highly respected and also because it affords motorists a wealth of scenic delight. Before the road was built, lumbering ore wagons and 4-horse stagecoaches traveled a narrow, steep, and dangerous route. Mining thrived throughout its length, and it linked such bustling towns as Ironton and Red Mountain that are no longer there.

This segment of the San Juan Mountains still harbors great bodies of sulphide ores containing copper, lead, zinc, gold, and silver, and knowing mining men consider it dormant but not dead. In recent years the Treasury Tunnel was driven under the old Black Bear workings, affording an inexpensive means of getting the ore out without having to pump water and combat snowslides, both of which were costly items in the old days. That will likely serve as a pattern for future mining ventures in this high country when the aftermath of the war has subsided.

IN THIS ISSUE

OUR first article describes the most modern shop yet built by an American railroad to keep diesel locomotives running efficiently under the rigorous schedules laid down for them. The second article records the passing of a historic group of century-old houses that have been stripped from the tip of Manhattan Island, New York City, to provide space for the plaza of the Brooklyn-Battery vehicular tunnel. Then follows an account of the development of the fabulously rich petroleum resources of our Gulf Coast region.

DIESEL POWER ON THE BURLINGTON ROUTE

The Chicago, Burlington & Quincy Railroad, including subsidiaries, has 11,000 miles of line in fourteen states. The system extends from Chicago, Ill., St. Louis, Mo., and Minneapolis, Minn., on the east, to Denver, Colo., and Billings, Mont., on the west, and southward to Galveston, Tex. The Burlington pioneered main-line, diesel electric-locomotive passenger-train service in America with the stainless-steel, streamlined "Burlington Zephyr" that was put in service on November 11, 1934, on the round trip between Kansas City, Mo., and Lincoln, Neb. Since then it has added steadily to its "Zephyrs" and also has been a leader in applying diesel power to freight and switching services. Shown here are three of its diesel-powered trains. One of the "Twin Cities Zephyrs" that run between Chicago and Minneapolis is shown at the right traveling along the shore of the upper Mississippi River. Below it is the "Exposition Flyer" that runs from Chicago to San Francisco. Pictured in the center is a 5400-hp. locomotive hauling a trainload of petroleum in Sheep Canyon, Wyo.

GROOMING THE NEW IRON HORSE

THE increasing use of diesel-electric locomotives for railroad haulage is creating a demand for shops designed expressly for taking care of this new type of iron horse. The diesel is the blue blood of the railway stable, a costly "animal" that warrants special attention to make sure that it will be in running condition most of the time. The traditional methods and facilities that have well served its steam-driven cousins aren't suitable for this newcomer. The diesel has the stamina of a race horse, along with the speed that makes it so desirable. It can and does regularly travel 1000 miles and more at a clip with scarcely any attention on the way. It goes for months or even years without requiring major repairs or overhaul, far eclipsing the venerable steamer in this respect. It is valuable to the railroads because of these things; so valuable, in fact, that when it does have to have attention it merits special handling to get it back on the road as quickly as possible.

Most railroads have not yet had to consider diesel-locomotive shops seriously because they have not needed them. As of February 1, 1946, there were 2993 diesel units in service, representing only a little more than 7 percent of all the locomotives on the nation's rail lines. In addition, there were 367 on order. Few have been run long enough to require major repairs. Only those systems that have been using diesel power for several years have thus far been obliged to provide shop facilities for them. Among them, the Chicago, Burlington & Quincy Railroad is concededly the leader. This is only natural, because the "Burlington" put the first diesel-drawn passenger trains in service and has had longer experience with diesel motive power than any other railway in the country.

So far as main-line passenger trains are concerned, the diesel locomotive was only twelve years old last November 11. The initial train was the *Burlington Zephyr*, a streamlined, stainless-steel assembly assigned to a daily round-trip run of 500 miles between Lincoln, Neb., and Kansas City, Mo. Considering that Rudolf Diesel invented his engine in 1892, it may seem that railroads we dilatory in adapting it to their need but that was not true of all of the Several lines, including the Burlingto were "diesel-conscious" in the 192 but engineering evolution had not y given them engines fit for high-spee heavy-duty passenger-train service.

The first diesel-driven locomotiv were low-speed switching units, t original one in this country having be purchased by the Central Railroad New Jersey in October, 1925. It i corporated a 300-hp. oil engine built b Ingersoll-Rand Company. The Burli ton acquired a 450-hp. diesel switch e gine in 1933. Others were added lat

GENERAL VIEW IN WEST BURLINGTON DIESEL SHOP

This bay of the steam-locomotive shops was equipped for its present purpose, starting in 1943, and is now among the finest and most complete diesel-locomotive workshops maintained by any railroad. It has 70x800 feet of floor space. Approximately one-third of its length is beyond the office enclosures and out of range of the camera's lens. Wheels and axles are handled in the left foreground, beyond which are large tools and special equipment. Trucks are repaired and rebuilt at the near right, and beyond that section is the electrical department. This picture was taken without advance notice on a regular working day and gives a good idea of the cleanliness and orderliness of the shop. Overhead is a continuous skylight of heat-resisting glass to keep down summer temperatures, and most of the left wall is glazed. To augment daylight there are mercury-vapor lamps overhead, with one row of incandescents to neutralize their blue light. The concrete floor is waxed to prevent oil from penetrating the pores and to help keep it clean. Two janitors, working full time, mop it every three weeks. Haulage equipment is all rubber-tired to protect the floor. Eighteen different-colored paints are used on the structural work, piping, etc., many of them for the purpose of identifying the various services.

and the officials of the road were impressed with their economy and sturdiness. In the early 1930's a high-speed, streamlined passenger train began to take shape in their minds. However, diesel power was not then included in the plans because no engine had yet been developed that was suitable for the purpose. That suitability came, according to President Ralph Budd, when improvements in design and strong new metal alloys reduced the diesel's weight from upwards of 150 pounds per horsepower (before the 1920's) to 21 pounds. How promptly the Burlington acted when that time came was recounted by Mr. Budd in a talk he made in 1937.

"The first of these lightweight engines I ever saw were the two which were at once an exhibit and also the power plant that operated the General Motors Building at the Century of Progress in Chicago in the summer of 1933. Many times we visited them and visualized one of them in the Burlington's new streamline train which was then being built. We had a great disappointment when the information came that the Winton people were being delayed in turning out our engine because they found it more difficult to cool on a train than on the shore of Lake Michigan. There were, in fact, some weeks of delay because of this, but we were all delighted, and felt repaid for waiting, when in early 1934 the engine was pronounced satisfactory for installation. Soon thereafter, on April 7 to be exact, the train came out, and two days later on its trial trip between Philadelphia and Perkiomen Junction, made 104 miles an hour. This is how close on the heels of its readiness for high-speed train service the diesel was put to work." Before that train was placed in regular service, it made a dawn-to-dusk test run on April 9, 1934, from Denver to Chicago, covering 1015.4 miles in 785 minutes. Its average speed was 77.6 miles per hour and its top speed 112.5 miles per hour.

The diesel locomotive exceeded the expectations of the Burlington officials. They had originally intended to use it mainly for unprofitable runs that had to be maintained to serve the public. They

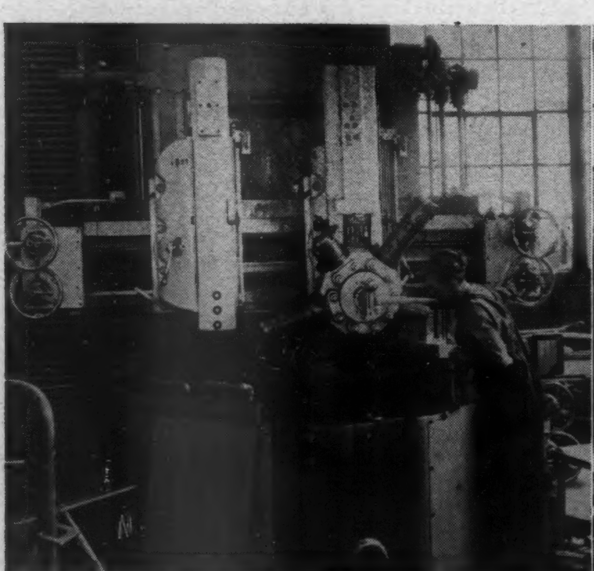
ENTRANCE TO DIESEL SHOP

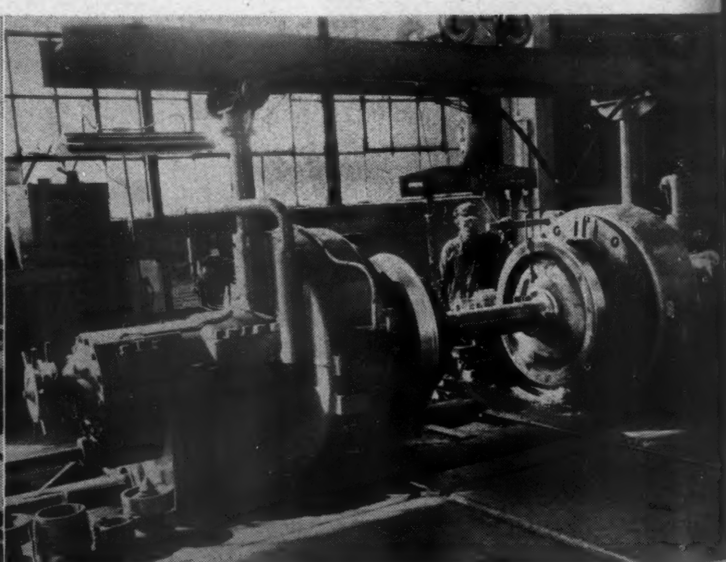
The sign over the door reads: "You are your brother's keeper. Protect him, yourself, and your family. Work safely always." In the foreground are locomotive wheels and axles that have been shipped to the shop for attention. After being reconditioned they will be returned to one of the terminals where replacements are made as required.

had hoped that it would reduce operating costs in such instances and, also, that it would be more popular than the small steam trains or the gasoline-electric cars that were being used. Both these hopes were realized to an extent that caused estimates of the diesel's capabilities to be revised. Its economy and travel appeal were so pronounced that plans were made to assign streamlined diesel-powered trains to longer and more important runs. In June, 1935, two trains —the *Twin Cities Zephyrs*—were placed in service between Chicago and Minneapolis on schedules calling for a round trip of 882 miles daily. The following year the *Denver Zephyrs* started running between Chicago and Denver, with a train covering the one-way distance of more than 1000 miles overnight.

Since then more diesels have been added steadily, and the Burlington (including The Colorado & Southern and the Fort Worth & Denver) now has 170 such locomotives. They consist of 27 passenger units, ranging from 600 to 4000 hp.; 21 freight units ranging from 260 to 5400 hp.; and 122 switching units, ranging from 360 to 1000 hp. They represent 14.6 percent of the road's total motive power. These 170 diesels average more than 1,250,000 miles a month, or 55 percent as much as the road's 958 steam locomotives that are still serviceable and aggregate 2,275,000 miles. T[illegible] figures out to around 7353 miles month[illegible] for each diesel as compared with 2[illegible] miles for each steam locomotive. The [illegible] diesel freight locomotives handle on [illegible] average 3928 gross tons per train-m[illegible] at an average speed of 30.9 miles [illegible] train-hour, as against 2233 gross to[illegible] per train-mile at an average speed of [illegible] miles per train-hour for steam freig[illegible] locomotives. The diesels are carrying [illegible] percent of the total freight load; t[illegible] passenger diesels are hauling 59 perc[illegible] of the total passenger cars; and t[illegible] switch diesels do 70 percent of all [illegible] switching. The diesel passenger un[illegible] each average 20,000 miles per month, [illegible] 666 miles per day; the freight-locom[illegible] tive average is 14,000 miles per mon[illegible] or 466 miles daily; and the switching [illegible] comotives average 4000 miles per mont[illegible] or 133 miles per day. Thus the passe[illegible] ger and freight units, which repres[illegible] only 28 percent of the total diesel pow[illegible] make approximately 62 percent of t[illegible] aggregate diesel mileage.

The *Denver Zephyrs* entered service [illegible] a schedule that cut ten hours, or t[illegible] equivalent of a full business day, fro[illegible] the then fastest running time of 26 hou[illegible] between Chicago and Denver. Trav[illegible] ing westbound, the distance of 10[illegible] miles is made in sixteen hours at [illegible] average speed of 65 miles per hour, [illegible] cluding stops. The eastward trip, co[illegible] ering 1034 miles, is made in 15 hours [illegible] 35 minutes at an average speed of 6[illegible] miles per hour. These 10-car, stream[illegible] lined, stainless-steel trains became po[illegible] ular immediately. In consequence, mo[illegible] diesel motive power was gradually adde[illegible] and now handles all the through passe[illegible] ger traffic and most of the local schedul[illegible] on the entire Chicago-Denver lin[illegible]





TWO MACHINE TOOLS

Typical examples of the modern equipment that insures precision repair work on every part of a diesel locomotive. At the left is a Bullard boring mill machining a locomotive wheel. The other picture shows a wheel-flange grinder. Note the tracks in the floor over which the wheels, with their connecting axle, are run up to the machine. There they are lifted into position for machining by an Ingersoll-Rand D6 air hoist suspended from a wheeled truck.

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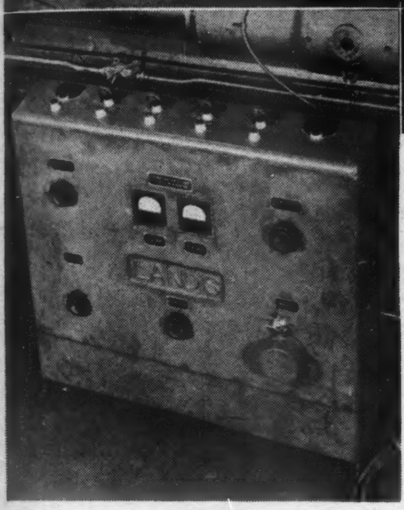


LARGEST OF ITS KIND

This 57-ton crankpin grinder, which accommodates crankshafts up to 230 inches long and weighing up to 5000 pounds, can handle the biggest shafts yet made for diesel-locomotive engines. An auxiliary headstock and footstock permit it to grind axles when cranks do not keep it busy. It uses carborundum grinding wheels ranging from 36 to 54 inches in diameter and having face widths up to 4 inches. The grinding-wheel head alone weighs 4000 pounds. Special provisions are included for balancing crankshafts before grinding starts. An electric control panel (left) has push buttons for starting and stopping the various electric motors that operate the machine, as well as field rheostats for adjusting the speed of the drives. Two ammeters enable the operator to determine before grinding whether a crankshaft is perfectly balanced. All motors may also be started and stopped by push buttons within convenient reach of the operator's accustomed position at the handwheel feed, where he is shown in this picture. The grinder occupies 12x52 feet of floor space. It was built by Landis Tool Company of Waynesboro, Pa., which specializes in precision-grinding machinery.

Other Burlington diesel trains make comparable speeds, although over shorter runs. The morning *Twin Cities Zephyr* covers the 427 miles between Chicago and St. Paul in 375 minutes, and makes the 54.6 miles between East Dubuque, Iowa, and Prairie du Chien, Wis., in 39 minutes, averaging 84 miles an hour. It is credited with being the fastest train for that distance in the United States.

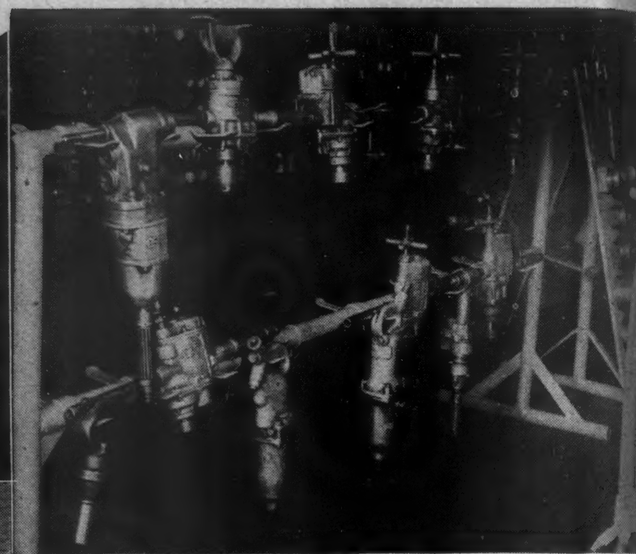
One of the greatest advantages of diesel over steam locomotives is that they can be maintained in good running order from day to day, thereby avoiding frequent and extensive visits to the shops. It is not unusual for mechanics to ride diesels to make repairs while they are in service. Diesel passenger and freight locomotives are built in units, with three or four engines making up their power plants. This renders them very flexible, and in case of emergency they can continue with one engine out of commission. Before the run is completed, the necessary repairs may have been made.

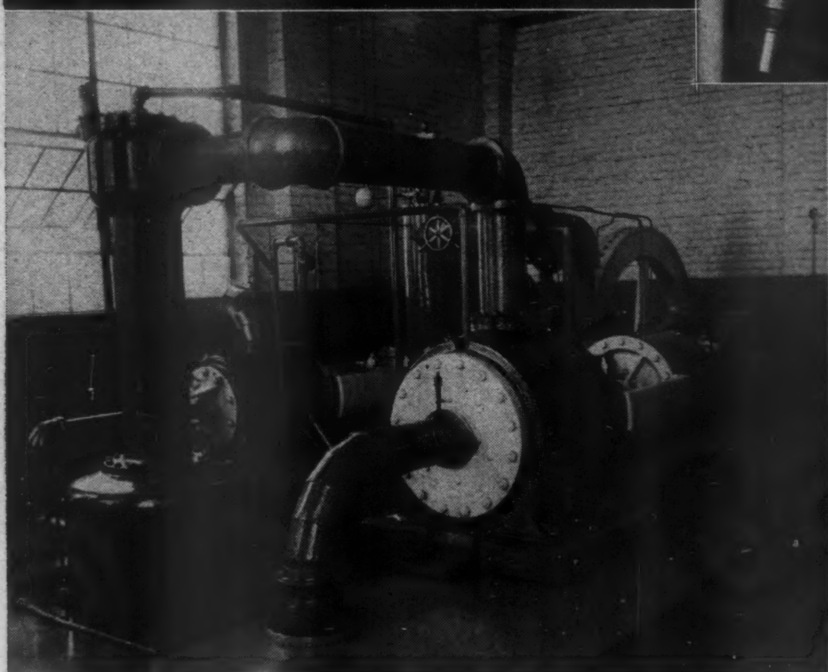
All Burlington diesel locomotives undergo thorough inspection on a mileage basis, the schedule varying with the three types in service. At such times, a general check is made of the functioning of the entire unit, and a more detailed examination is made of vital parts or of those that experience has shown are most likely to need attention. Special note is taken of the condition of engine pistons and connecting-rod bearings. Traction motors also are carefully inspected and serviced, lubricating oil is changed, filters are cleaned, and numerous other maintenance details are looked after.

It is difficult to make direct comparisons between diesel and steam locomotives as to their major-repair requirements, because diesels have not been used long enough to establish definite figures that can be taken as averages. Railroadmen are therefore reluctant to reduce the comparison to hard and fast mathematical ratios, although there is a big margin in favor of the diesel. Steam locomotives regularly visit the shop for general overhaul on an average of every 150,000 miles. No one so far wants to say what the corresponding mileage is for the diesel, but there is every indication that it is at least 500,000. Leaving out man-made failures, many Burlington diesel units have gone 1,000,000 to 1,200,000 miles without requiring major repairs, and some have covered 1,400,000.

This phase of the diesel's desirable characteristics can be summed up in what is called its availability for service, which is the percentage of total time that it is ready for duty. Burlington-system statistics show that its passenger diesels are available 95 percent of the time. For freight locomotives the figure is 86.7 percent, and for switchers it is 97.6 percent. In view of that locomotive's rugged constitution, it might be argued that there is comparatively little need of providing shops for its care. The reverse is the case, however, for at least two good reasons. To begin with, the diesel's first cost is high, being somewhere around double that of a steam unit of equivalent horsepower. Consequently, there is a big investment that merits protection. Because of this initial cost, and also because the diesel is available for service so much of the time, few spare units are kept in stock.

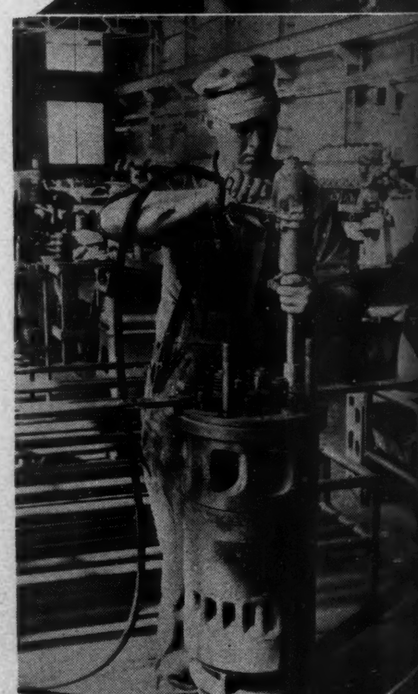
A locomotive assigned to a certain run is expected to be in order for duty almost all the time, which means every day. If it is to meet this demand, it must be scrupulously maintained. Careful attention to minor defects and regular servicing postpone major repairs, but the latter must be made eventually, and it is important that they be handled with the least possible delay. It is ap-





PNEUMATIC POWER

Numerous operations in the shop at West Burlington are simplified and expedited by means of pneumatic tools. The two men pictured at the top-left are using a large impact wrench to remove a crab nut from an engine part. Shown in the right-center is a Multi-Vane grinder equipped with a wire brush for cleaning an engine cylinder head. The workman at the bottom-right is applying nuts to studs on the cylinder liner of a diesel engine with a Size 508 impact wrench. When not in service, pneumatic tools are stored in a tool crib from which they are issued as needed. Some of them are seen at the top-right on a special rack where the one that is wanted can be readily located and removed. Compressed air for both the steam- and diesel-locomotive shops is supplied by two venerable steam-driven compressors, one of which is illustrated just above. It is an Ingersoll-Sergeant piston-inlet machine that has been in use since about 1906. The vertical column at the left is an intercooler.



parent that the requirements demand widespread facilities for maintenance and for running repairs, a few strategically located shops equipped for overhauling jobs and all but major repairs, and one centrally located shop for major repair work and for complete rebuilding of units. That, in general, is the Burlington scheme.

Since they run fewer miles a day, switching locomotives do not need repairs so often as the two other types. Means for keeping them in condition are provided at twelve of the road's important terminals where they are in use. Most of them are withdrawn from service one 8-hour period a month for checking and inspection. Running inspection and light maintenance are ordinarily taken care of each day while the crews are eating lunch.

At Clyde, Ill., near the Chicago terminal, a new shop has been outfitted for changing trucks, wheels, and traction motors, for repairing electrical equipment, and for doing heavy maintenance work on diesel freight-locomotive engines, as well as on engines of switching locomotives in the adjacent territory. Passenger locomotives are attended to at

the Fourteenth Street Yard in Chicago, where a drop pit and other facilities have been installed. At Denver, a 3-stall shop has been built to handle light running repairs. Both the Clyde and Denver terminals are provided with spare trucks, wheels, and traction motors that are used as replacements. Transfers can be effected in a few hours, permitting locomotives to meet their service schedules.

All the diesel freight locomotives are assigned to time-freight trains and are routed so that they reach the Clyde shops for a check up at regular intervals. For example, a unit that hauls a train from Chicago to Denver goes back to Lincoln, Neb., and thence to Sheridan, Wyo., and return. At Lincoln it is attached to a main-line train en route to Chicago, where it receives major running maintenance.

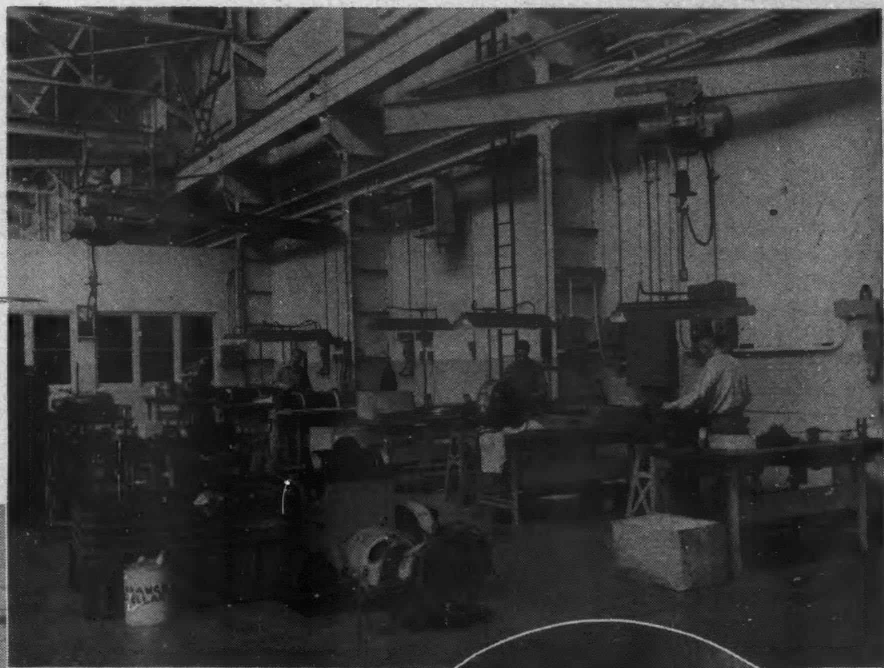
Heavy repairs to diesel locomotives of all types are made in a section of the Burlington's main locomotive shops at West Burlington, Iowa. One large bay has been given over for the purpose and been equipped with machinery designed especially for the work. Although it occupies a part of an old building, the interior has been entirely transformed and it is a new shop in every respect. It has facilities for everything that must be done to a diesel locomotive and its component parts, and is without doubt one of the finest establishments of its kind.

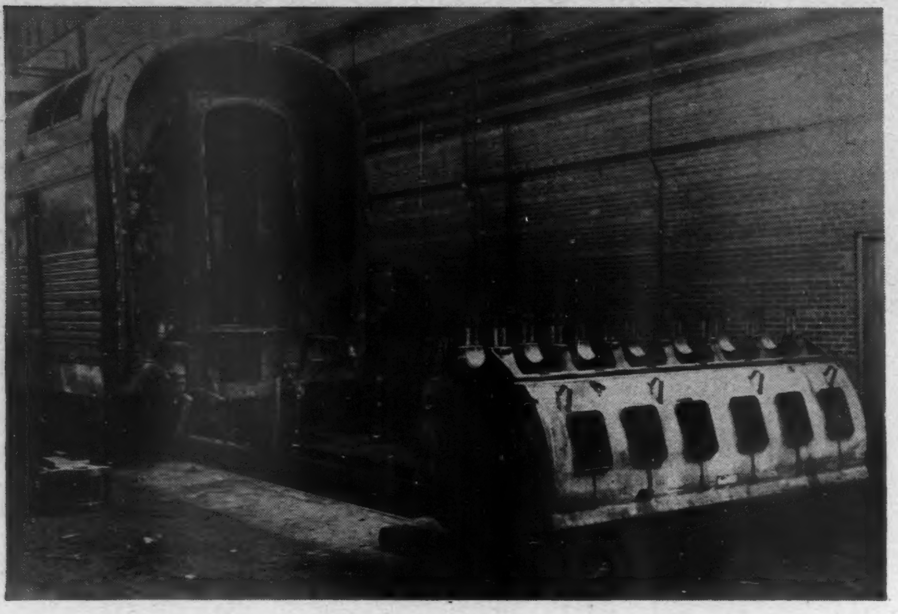
Only a wall separates this bay from the steam-locomotive shops, but there is a startling difference between the two areas. Even with good housekeeping, a steam-locomotive shop is inevitably grimy and smoky. By contrast, the diesel bay is the acme of cleanliness. In converting it for its present service it was completely renovated. Skylights and artificial illumination make it actually lighter than day, and it is resplendent with shiny paint. Everything is orderly, and litter is not allowed to accumulate. There is a bit of psychology in this, and it pays off. In such surroundings men do their best work. They realize that diesel locomotives are costly and worthy of their best efforts and they take pride in contributing to the shops' over-all efficiency.

It is appropriate that these shops should be located where they are, for Burlington is historically important in the realm of transportation. Long before white men visited the area, it was neutral ground for the Indians who came from long distances to replenish their supply of flint for arrowheads, digging the material from the bluffs that are visible from the present City of Burlington. The redmen called them Flint Hills,

ELECTRICAL DEPARTMENT

The armature section of the electrical-repair department is shown directly below. At the bottom-right is pictured a small armature on a Gisholt dynetric balancing machine. A numbered tape is placed around it and it is then rotated. Mounted on the front of the machine (at the operator's elbow) is a Stroboglow lamp that flashes for approximately ten-millionths of a second each time the voltage generated in pick-up coils changes from negative to positive. The flashes coincide with the vibrations caused by the unbalance of the rotating armature. The number that marks the location of the unbalance then apparently stands still and can be read clearly. A dial on the machine indicates the amount of correction that is needed to restore balance. Armatures are impregnated with insulating varnish by means of the Devine impregnating equipment illustrated at the bottom-left. The tank behind the man is for storing, heating, and mixing the varnish and is connected by under-floor piping with the impregnator at the right. After an armature has been placed in the chamber the latter is evacuated by a dry vacuum pump. The varnish is then admitted and air pressure applied to effect impregnation.





STRIPPING TRACK

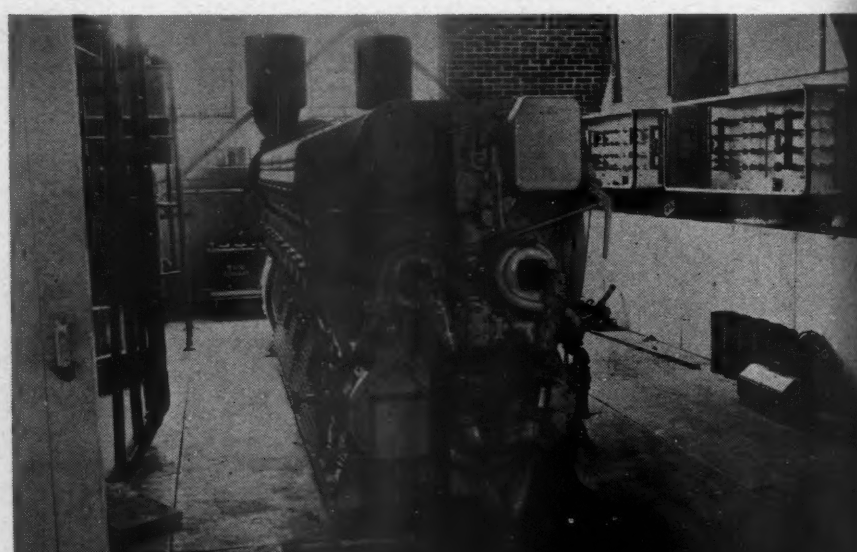
To keep the diesel shop clean, locomotives brought in for attention are dismantled on this track in the steam-locomotive shop, and the parts on which work is to be done are then taken into the adjoining section. Shown here is one end of the locomotive from a stainless-steel streamlined "Denver Zephyr" train. The locomotive consists of two cars, one equipped with two 12-cylinder, 900-hp. engines and the other with one 16-cylinder, 1200-hp. engine, or a total of 3000 hp. All diesel passenger locomotives on runs inaugurated since 1936 standardize on 1000-hp. engines. In the foreground is the stainless-steel crankcase of a 900-hp. engine from which the superstructure has been removed. This locomotive has been in service since October, 1938, and visited the shop for engine repairs and for the renewal of all its electrical cables.

and that was the first name given the settlement which sprang up there on the west bank of the mighty Mississippi River. It owed its first growth to the traffic that flowed on that stream. Not far below it is Hannibal, Mo., the playground of Mark Twain's immortal Huckleberry Finn.

The Burlington & Missouri River Railroad was incorporated in Burlington in 1852, and in 1855 the rails of the Chicago, Burlington & Quincy reached East Burlington from Chicago. Trains crossed the river on ferries until 1868, when a bridge was built on the site of the present 2-track structure which dates from 1892. The shops at West Burlington were established in 1883. Three years later, the famous Burlington Trials that resulted in proving the value of George Westinghouse's air brake for freight trains were conducted on the stretch of track that passes the shops and descends the slope into the river valley. All the equipment, including Westinghouse's, tested there in 1886 and again in 1887 under the auspices of the Master Car Builders' Association was rejected, but the failure spurred on Westinghouse. He devised his quick-acting triple valve immediately afterward, and then, while the subject was still uppermost in the minds of railroadmen, sent around the country on a demonstration tour the same 50-car train that his earlier brake had stopped with damaging abruptness at Burlington. With the aid of this improvement he brought it to a stop from a speed of 20 miles an hour in 200 feet without spilling a drop from a full glass of water in the last car. General acceptance of his brake by every railroad line in the States followed. Officials of the C.B.&Q. always have had a soft spot in their hearts for Burlington. In 1934 they exhibited the first streamlined diesel train there before assigning it to duty, and in the following year they gave the city diesel-service of its own by inaugurating the run of the *Mark Twain Zephyr* to St. Louis.

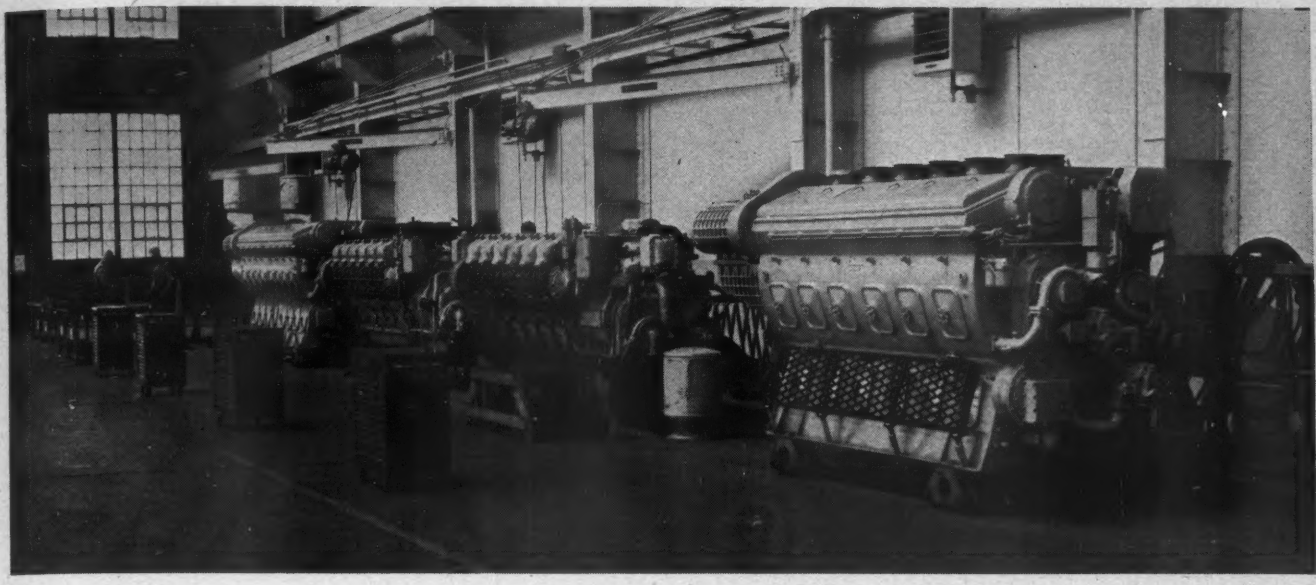
Originally, diesel repair work was done in different parts of the steam-locomotive shops. A start toward a separate establishment was made by setting aside one corner of the present bay, which was once a heavy machinery shop. The movement to convert the space began in 1943 and was carried out gradually. This involved relocating 160 machines and buying and setting up many others to provide the most modern facilities for the work. Several of them were built to order; at least one is the largest of its type ever manufactured; and some have cost many thousands of dollars.

The shop does not often receive a complete locomotive for repairs. On first thought this may seem strange, but it is the logical result of the general scheme that has already been outlined and under which the bulk of the maintenance and repair work is done at terminal shops or even on the road. Barring damage sus-



TESTING A REBUILT ENGINE

After reassembly, each propulsion engine is tested thoroughly before being approved. Shown here is a 1350-hp. engine from a freight locomotive. At its far end is a generator of the same rating that it drives in service. The engine is first operated for gradually increasing short periods, meanwhile being speeded up until it reaches peak firing pressure in each cylinder. Finally, it is run for an hour at each of the seven operating positions, forward and reverse. Temperatures of the oil, water, and bearings are taken at regular intervals throughout the test. The current generated goes to two 1500-ampere resistors (right) where it is converted into heat. In warm weather it is discharged from the building; in winter it is used to help heat the shop.



ENGINE-ASSEMBLY LINE

These engines have been reconditioned and tested and are ready to replace similar units in locomotives as the latter arrive at the shop. At the near end is a 1000-hp. engine for a passenger locomotive. Next to it are two 900-hp. units such as have been used in the "Denver" and "Twin Cities Zephyrs" since the present trains were placed in service in 1935. The fourth one is a 1350-hp. freight-locomotive engine. At the extreme left, workmen are beginning to assemble a third 900-hp. unit. Left of the engines is a row of "Snap-On" tool cabinets. One of these is assigned to each mechanic. It contains everything he normally needs in his work arranged in a series of pull-out drawers. After use, each tool is returned to its place. The cabinets are mounted on wheels for portability, and over each is an electric light so the tool wanted can be readily located.

tained in wrecks, which have fortunately been rareties, the only time a locomotive is sent to West Burlington is when it becomes necessary to remove one of its main propulsion engines or generators. In the case of an engine, this happens only when there is crankshaft failure. All other repairs are made in the car.

The shop does, however, work on all the component parts of diesel locomotives, from trucks and wheels and traction motors to the numerous and varied pieces of auxiliary equipment. This can be done without bringing the locomotives themselves to the shop because the Burlington has a unit exchange system under which spare traction motors, trucks, auxiliary generators, and other parts or assemblies are kept on hand at Clyde, Denver, and the other terminals where switching locomotives are maintained. As a result, it is necessary only to substitute a new or rebuilt unit for the one that has failed, and this can usually be done during the lay-up period of the locomotive which, consequently, loses little or no time from service. Traction motors are changed on a regular mileage basis, regardless of their condition. Those in the *Denver Zephyrs* and *Twin Cities Zephyrs* run 150,000 miles; those in other locomotives, 200,000 miles. There is a 7-year limit on the service of main generators in switchers, but none on that in passenger or freight units.

Several main engines and main generators of each size and type in use are kept on hand at West Burlington, as all changes of these assemblies are made there. When a locomotive is received for a replacement of this kind, the shop works around the clock to get it back on the road as soon as possible. Each time such a change is made, the methods and routine are improved upon with a view to cutting down the working period. Thus far only seven engines have been replaced in freight locomotives. In the case of the first one, substitution was effected in 24 hours; in the third, in fifteen hours. It normally takes from 32 to 38 hours to change an engine in a passenger locomotive because there is more equipment to dismantle and move. Replacement of a main generator in a freight locomotive requires eighteen hours.

The West Burlington diesel shop is organized into three departments: engines and their auxiliaries, electrical equipment, and trucks and wheels. There is a foreman over each department. When one of these assemblies arrives for attention, it is dismantled and all components are cleaned, inspected, and either repaired or renewed. A $1,500,000 stock of parts is carried to insure against delay in restoring any assembly to condition for service.

Except for about 15 percent of the work on diesel-engine fuel injectors, which is done elsewhere, the shop is entirely self-sufficient. Even crankshafts, which most railroads have to return to the engine manufacturer for regrinding, are handled by special equipment, which is illustrated. All crankshafts, gears, and axles are magnafluxed to reveal cracks or other flaws. Many other essential parts that are made of nonmagnetic metals are similarly examined by coating them with fluorescent paint and viewing them under black light.

The electrical department is provided with machinery for rewinding and rebuilding armatures and other electrical equipment. Four racks are installed for testing traction motors after they have been repaired or rebuilt.

The engine department takes care of the main engines, as well as auxiliaries such as air compressors for brake service, fuel and lubricating-oil pumps, oil filters, traction-motor blowers, radiator and fan assemblies, etc. On some locomotives there are auxiliary diesel engines that are used for driving air-conditioning systems. Main diesel engines are reassembled by production-line methods. After a unit has been put together it is tested under full load, as described in connection with the picture at the bottom of page 60.

Approximately 150 men are employed in the diesel shop. They are all drawn from the steam-locomotive shops and bid for the jobs on a seniority basis, as is the rule in railroad work. New men are placed with experienced ones until they learn the operations they are to perform.

The maintenance and repair of diesel locomotives comes under the over-all direction of H. H. Urbach, mechanical assistant to the vice-president, with offices in Chicago. O. E. Ward and C. E. Melker are superintendents of motive power located, respectively, in Chicago and in Havelock, Neb. W. A. Newman is superintendent of the West Burlington Shops and W. H. Horst is foreman.

THE OLD GIVAY

Tunnelers Raze 1825 "Millionaires' Row" at Historic Tip of Manhattan Island

Copyright, H. C. Brown, 1916

THE Battery at the southernmost end of Manhattan Island is now in the hands of topographical beauticians bent upon uplifting the face of that area while adding to the city's rapid-transit facilities. The incidental surface changes are due to the terminal plans for New York's latest twin-tube vehicular tunnel that will connect Manhattan Island with the Borough of Brooklyn by a subaqueous route 2.1 miles long between portal plazas. The men engaged in driving the parallel tubes are doing their rugged work with rock drills, pneumatic shields, and other air-operated equipment that are making it possible for them to forge ahead through deep-rock formations or the varying nature of the bed of the East River.

Millions of Americans do not know that the bustling City of New York has reached a physical state in sections of Manhattan that may be likened to the effects of high blood pressure and hardening arteries on the human body. The construction of the Brooklyn-Battery Tunnel will surely increase circulation of traffic by enabling thousands of vehicles to pass to and fro unimpeded between New York and Brooklyn daily, the clock round, instead of contending, as they now do, with a bottleneck caused by dependence upon intermittent ferries that span the water gap over which travel is recurrently slowed up because of fog and other weather conditions.

Just north of Battery Park there will be two portals to the twin tubes, and substantially two built-up blocks at the south ends of flanking Greenwich and Washington streets must disappear to provide suitable connections for them with the surface area. The structures on one block have already been demolished, and those on the other will be razed in the near future. House-wrecking within the Borough of Manhattan has been fairly continuous for many years to meet an increasing demand for change, betterment, and structural expansion, but the two blocks in question are of more than passing interest because of their intimate association with the city's development over a period of nearly a century and a quarter.

Henry Hudson—an English mariner employed by a Dutch trading company—landed on Manhattan Island in 1609 to replenish his reduced water supply, and there is every reason to believe that he first stepped ashore within a stone's throw of where Greenwich and Washington streets now start northward at Battery Place. About fourteen years later another Dutch organization landed there bent upon trading with the Indians and settling permanently on this continent. They sought a freedom that was not to be had in any part of Europe at that time. Director Peter Minuit, then in charge of the settlement, bought

GIV AY TO THE NEW

R. G. Skerrett

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land

THE RAVAGES OF TIME

In 1825, when they were new, the houses at the south end of Greenwich Street (extreme left) were known as "Millionaires' Row" and were occupied by some of New York's leading families. As the city expanded northward decadence set in, and in recent times the buildings have served partly as tenements and to house a miscellany of businesses. Their down-at-the-heels appearance is evident in the views at the left and below, but close inspection will reveal that some of them retained architectural details of their former grandeur. Now, all have been razed to form a thoroughfare at the Manhattan portals of the twin vehicular tubes which will extend under the bay to Brooklyn. The backs of the same buildings are shown in the center picture, which was taken shortly before they were torn down.

Photos, New York City Tunnel Authority

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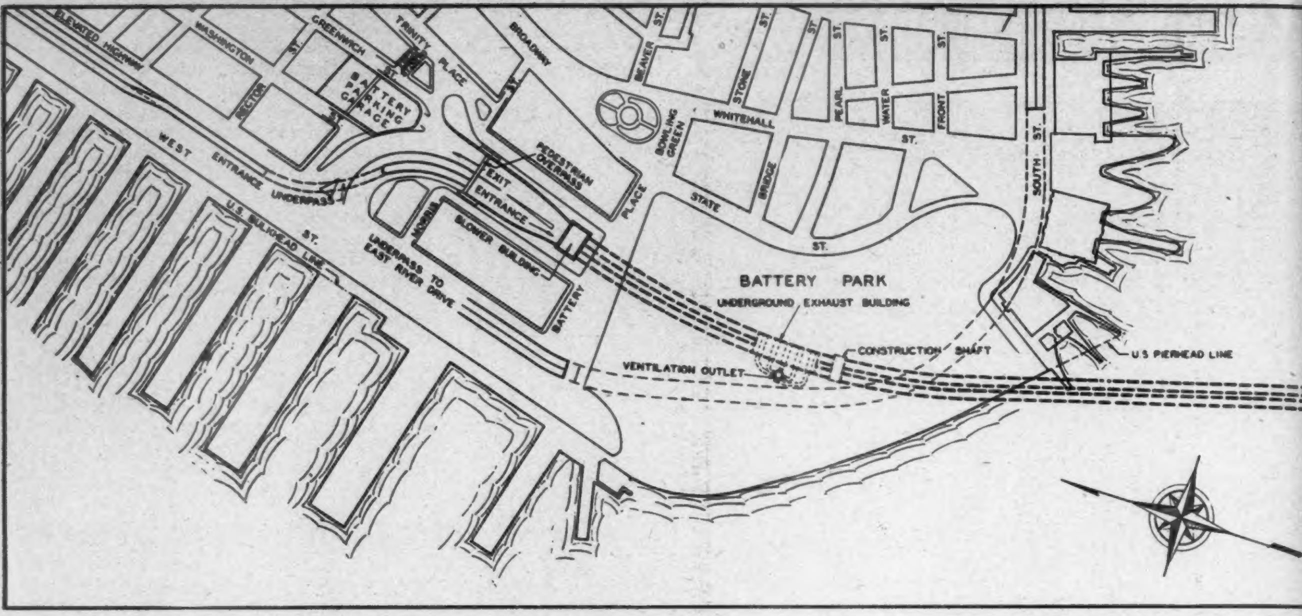
Manhattan Island in its entirety from the Indians with a collection of bright trinkets that had a probable value equivalent to about $24. He built Fort Amsterdam on a site close to the old buildings that must give way to modern progress.

The flag of the Dutch West India Company flew above the fort until September 8, 1664, when a British fleet, without firing a single hostile gun, made the surrender of New Amsterdam inevitable. The colors of England were then raised on the flagstaff to remain there until the American people declared their independence. When the settlement became a British one it had a population of 1000 people and the northern limit of the community was at a barricade that extended across the island from the North to the East River. The path paralleling that line was later to become Wall Street.

The Broad Way of that period ran southward from the wall to Fort Amsterdam, and the waterfront on the west side of the settlement lay close to the end of that thoroughfare. At that time and for many decades following, the area now occupied by the lowermost sections of Greenwich and Washington streets was intermittently submerged, and no efforts were made to reclaim it until long after work of that nature had been done along the east side of the island, where development was concentrated for years. Many of us may wonder why the early settlers preferred the East River waterfront.

In those distant days the merchant craft were small and seldom exceeded 50 tons burden. They were of timber construction and depended upon their sails for propulsion. In the wintertime there was much less hampering ice in the saltier waters of the East River and navigation was easier and safer. The pioneer slips and wharves were consequently constructed on that side of the town, and shipbuilders also established their yards there. Merchants engaged in foreign and domestic commerce erected their warehouses near the docks, and other business concerns and most of the retail shops were to be found convenient to the sources of supply, as well as to the residents across the waterway on Long Island who came to New York by ferry to do their buying.

Most people then dined in the middle of the day, and the meal was commonly a protracted and heavy one. It was therefore desirable to live close by so that the men could easily reach their homes and return to work. Subsequently, when trade increased and larger and more deeply drafted ships were needed, the east shore was successively extended outward beyond Pearl Street,



LOCATION OF MANHATTAN PORTALS OF TUNNELS

The buildings pictured on the two preceding pages were on the upper side of the block in which the words "Exit" and "Entrance" appear.

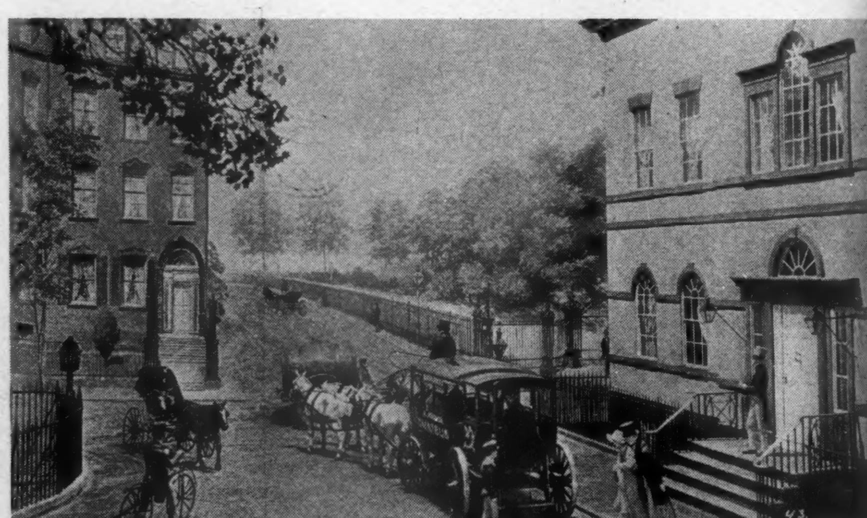
Water Street, Front Street, and, finally, South Street. In the end, sailing vessels and, later, steamships attained such proportions that they could be somewhat indifferent to ice in the North River. Then began the development of New York's west-side waterfront.

It is difficult to approximate the date when Greenwich Street took form from the Battery northward because of the confusion arising from the practice of early surveyors to make no clear differentiation between existing and projected features of the city on the maps published by them. But it is an established fact that Greenwich Street, from Duane Street north, existed as part of the road to Greenwich and Greenwich Village sometime after the conclusion of the Revolution, when New York began to revive.

Greenwich, which lay near the Hudson and about 2 miles beyond lower Manhattan, was first owned by the second governor of New Amsterdam, Wouter Van Twiller. Bossen Bouerie, as the property was named by him, subsequently became Greenwich after English people also were attracted to that community. But the latter really did not become well known to the citizenry of New Amsterdam until repeated yellow-fever epidemics from 1791 to 1822 drove many people into the suburbs, and especially to healthful Greenwich. Summer homes, as well as permanent residences, increased in number when the place could be reached over a shoreline road that was made secure against inundation through low areas upon occasions when the water was especially high. It was then—shortly after the War of 1812—that the section of Greenwich Street between Battery Place and Duane Street was constructed. Around 1820, many important municipal developments were undertaken, including the filling in of whole valleys, provisions for effective drainage, and the building of streets on reclaimed land. At that time, according to the census, New York City had a population of 123,706.

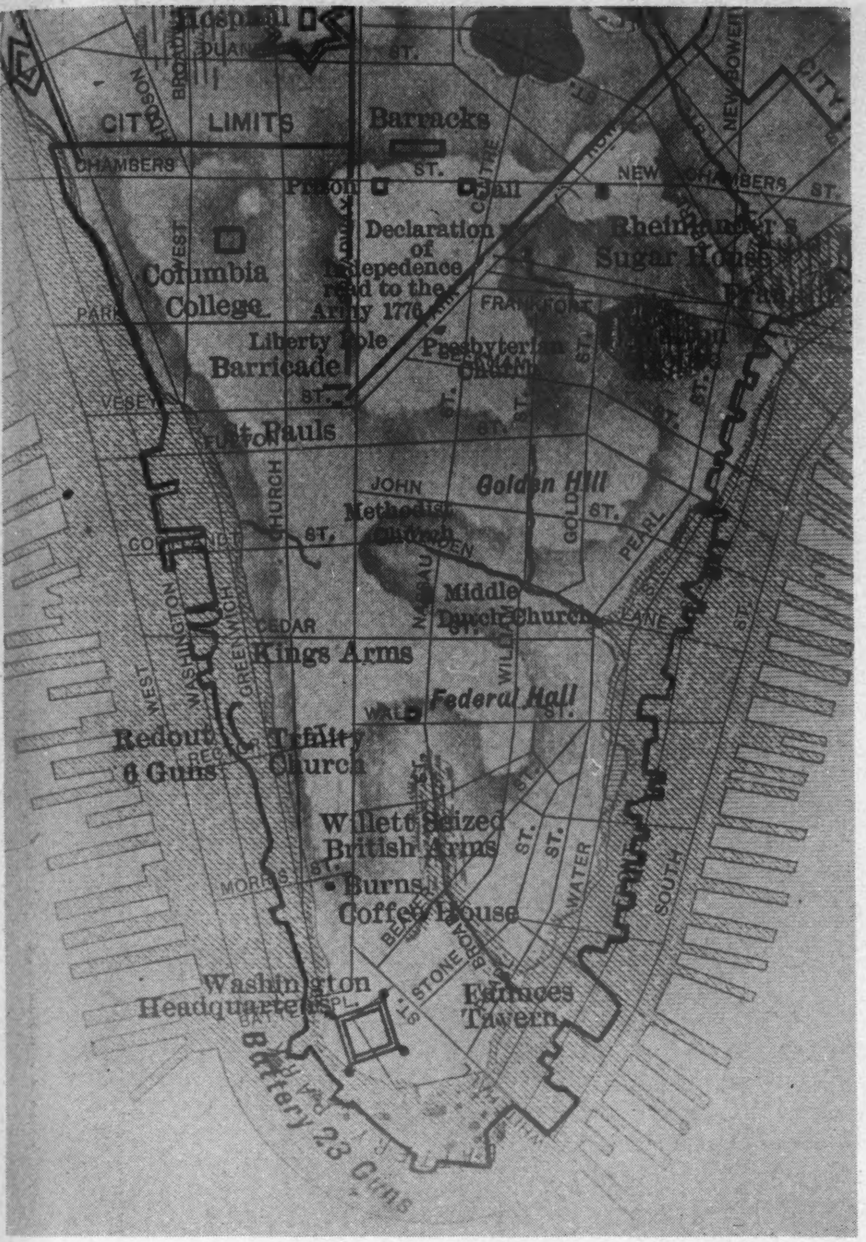
In writing about New York, the late Thomas A. Janvier made the statement that "By the year 1824, in which year more than 1600 new houses were erected—nearly all of them of brick or stone, the lines of the city blocks were advancing close upon Greenwich Village, and Greenwich itself was becoming a populous suburban ward." Contemporaneously, a row of fine houses was erected on Greenwich Street from a point just above Battery Place northward to Morris Street. They were owned and occupied by persons of social prominence and substance, and were currently known as "Millionaires' Row." An accompanying illustration of some of those residences gives an excellent idea of their architectural features, and it is natural to infer that their interiors were in keeping and characterized by the elegance and dignity of the period.

Those were days when every room had its open fireplace and a suitably



LOWER BROADWAY IN 1831

The house on the right was No. 1. The site is now occupied by a large building tenanted mainly by steamship-company offices. Across from it is a part of the iron fence surrounding the small park area known as Bowling Green. The same fence is there today. Now the U. S. Customhouse is located where the other house stands on the left. The 4-horse vehicle represents the first public omnibus operated in the city. Just ahead of the horses is a tun on wheels by which spring water was delivered to the householders. Battery Park is in the center background.



WHERE LAND WAS RECLAIMED

All the outlying areas indicated by broken lines were formerly underwater at times of high tide. As the city grew, they were filled in and now support buildings and piers worth many millions of dollars. The original town of New Amsterdam extended only to Wall Street, which gets its name from the fact that it marks the line of a barricade that was erected in the early days as a protection from marauding Indians. This map is undated, but notations on it refer to Revolutionary War times. However, the artist may have merely brought an old map up to date.

carved marble or mahogany mantelpiece. Usually, wide stairways with mahogany handrails and newel posts led to the upper chambers; and mahogany furniture and other accompaniments of luxurious living were in evidence. Even so, the best water to be had in those homes was drawn mainly from cisterns that stored rain water, because that supplied them by way of the wooden mains of the Manhattan Company, chartered in 1799, came from sources that left much to be desired in purity and clarity. The same can be said of the scattered wells that, with few exceptions, were tainted with brine, if not something much more distasteful.

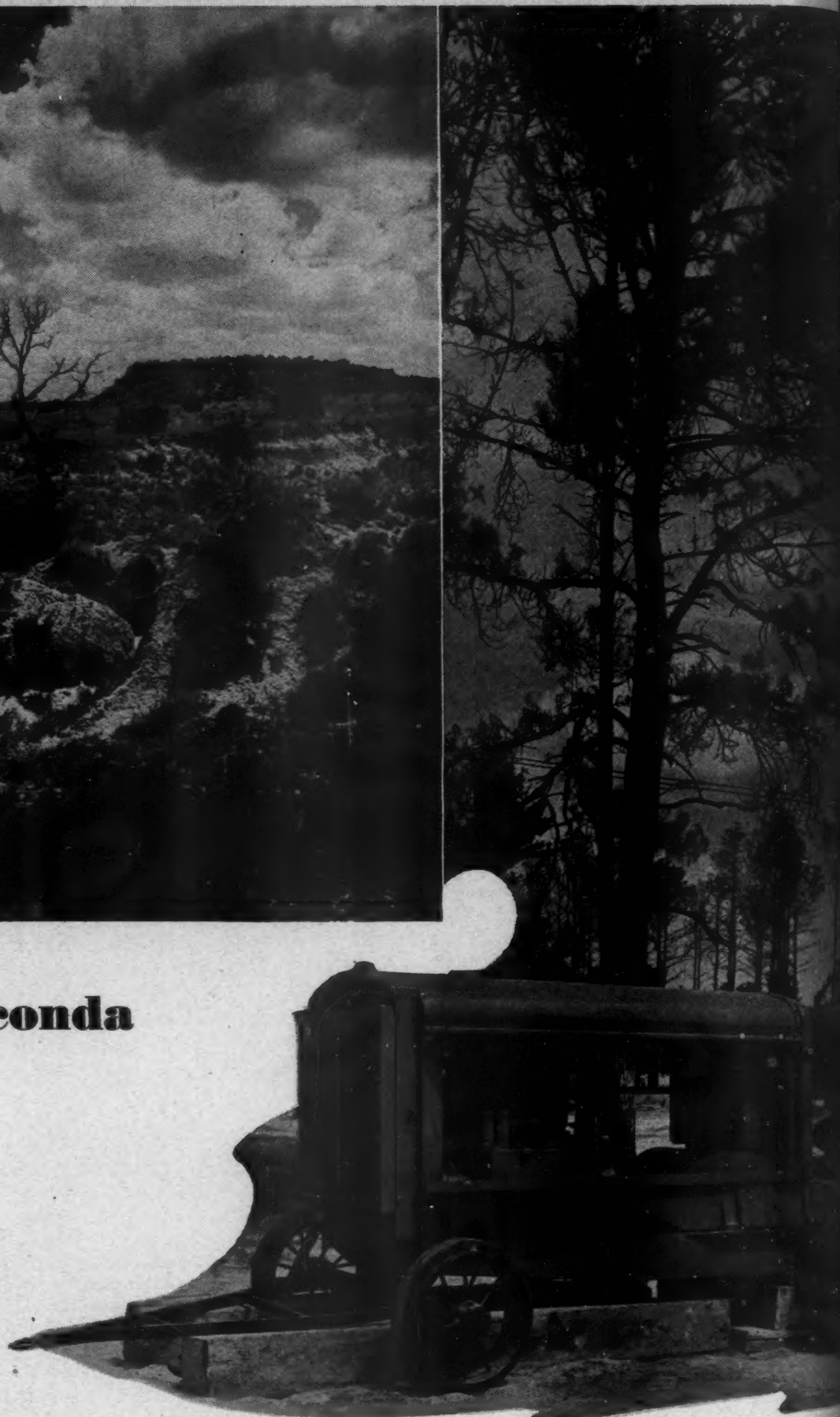
Millionaires' Row must have been occupied in 1824, because a belief is recurrent that General Lafayette, who returned to this country that year, was a guest in one of those homes. The latter were sturdily built and have more massive walls than kindred structures of later decades. It was probably because of these characteristics that many of the houses in the two blocks that have to be cleared were raised several stories to suit the purposes of subsequent owners and the decidedly decadent uses to which they were put. Most of them have stood in sorry contrast with the towering modern business buildings to the east and west; but, despite their "social decay," some of them still retain their fanlights over front doors, their original window capstones, their aged doorsteps, and their iron newel posts and balustrades, as if mutely protesting the humiliation imposed upon them.

Those old structures have seen all the changes that have taken place in and around Battery Park in 120-odd years. They have seen Castle Clinton—the fort which never was called upon to defend the city and which originally lay 300 feet offshore from the Battery seawall—pass back to the city from the Government to become Castle Garden, initially a place of amusement, then an immigrant landing station, and, finally, the New York Aquarium, now abandoned. While Castle Garden was an immigrant depot, some of the buildings on the condemned blocks afforded temporary and even longer accommodations for the newcomers; in recent years they have served as tenements and places of business of many kinds.

In clearing the two areas for the Brooklyn-Battery Tunnel, the first step is to raze the houses to the first-floor level and then to tumble whatever remains above ground into the shallow cellars. Readapting the properties to the present requirements will involve a good deal of excavating that will be done with power shovels, bulldozers, rock drills, paving breakers, and the like. When these operations are in progress we shall learn how support was established in unstable ground for those structures that have stood so long firmly planted. Perhaps we shall also discover that the lessons learned in extending the east-side waterfront and upbuilding that area on made ground were applied on the North River side of the city when the land that is now Greenwich Street, Washington Street, and West Street was successively reclaimed and developed for building purposes. As the work goes on the antiquary will be on the watch, and already some museum pieces have been salvaged from the houses razed.

No buildings in New York City that have endured for nearly a century and a quarter could fail to arouse interest because of the contrast they offer with present-day practices. It would take a long recital just to outline the momentous things that have marked the years that have intervened since the rearing of those structures that are now giving way to the Brooklyn-Battery Tunnel. That great project is under the immediate direction of Ralph Smillie, Chief Engineer, New York City Tunnel Authority.

Editor's note: A later issue will contain a comprehensive description of the Brooklyn-Battery Tunnel.



Gulf Coast Golconda

L. A. Luther

In the early days we were just a few,
and we hunted and fished around,
Nor dreamt by our lonely campfires of
the wealth that lay under the ground.

Till sudden there came a whisper . . . .

—Robert W. Service

SERVICE'S Alaskan sourdoughs were hardly more oblivious to the wealth that lay underground than were the pioneers at the opposite corner of our empire, the Gulf Coast. And the rugged terrain and truculent climate of Alaska seem more capable of concealing treasure than the flat, dreamy bayou country, where the occasional tiny hump of a salt dome could intrigue the imaginative eye of a geologist.

Jean Lafitte the pirate, that strange Robin Hood of the sea, sailed his sinister, slim-masted *Jupiter* from Bayou La Fourche to Corpus Christi, never dreaming that virtually beneath his keel lay mountains of yellow sulphur and pools of "black gold" on which one of the mightiest of navies would literally float to victory in two world wars. Neither could he foresee that men would some day joust to the death in the upper air on wings powered by that petroleum. For more than a century, Spaniards trod Texas soil. But nothing discovered there aroused much interest in continental Spanish circles; they never gave the country a name or definite boundaries; and Cortez's failure to find and loot the seven fabled Cities of Cibola turned their minds to other fields.

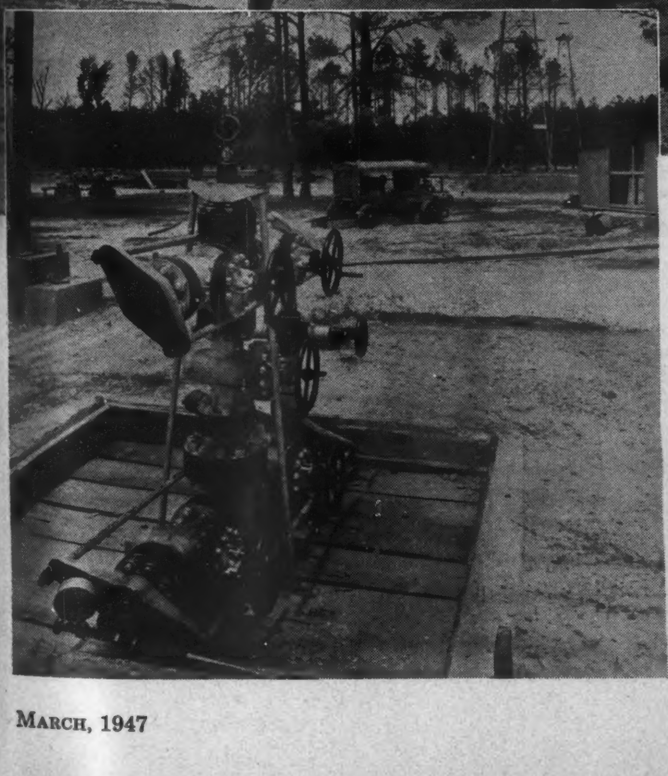
The many legendary heroes of the Lone Star Republic, among them Austin Travis, Bowie, and Crockett, made their names Texas watchwords and battle cries. They won for themselves enduring renown; but they fought, languished in Mexican prisons, and often died for an idealized state whose economy was pastoral and whose highways bore the charmingly descriptive name of "trace." Sam Houston, as president of the fledgling Texas Republic, carried on a lively flirtation with Great Britain in the singlehearted hope of creating jealousy and desire for annexation in Washington; yet he did not offer, or know he possessed, any treasure trove. England's patronizing interest in Texas as a country cousin

envisioned no dowry more alluring than hides and leather. Had John Bull sensed that this daughter of Goliad and the Alamo was girdled with wealth which one day would make the riches of all fabled cities appear almost trivial, or had he foreseen that the peace of the world would be poised precariously between great pools of petroleum, perhaps the course of empire in the eighteenth century might have taken a different turn.

But if the chancelleries of that time were not yet aware of the military implications of oil, neither had that pungent commodity found honor in its own country. Such seepages as escaped from nature's camouflage were collected and sold largely as nostrums for curing colds or fighting vermin. In 1825, a water well in Nachitoches Parish in Louisiana was reported to have struck oil four times, an early augury of the 22 oil-bearing horizons penetrated by some later and much deeper wells. In Wichita County, Texas, many shallow pools produced oil at depths of 140 to 500 feet; and Waggoner, a rancher, who was later to become wealthy from oil, fumed in disgust when a new water well brought in a flow of oil at hog-killing time.

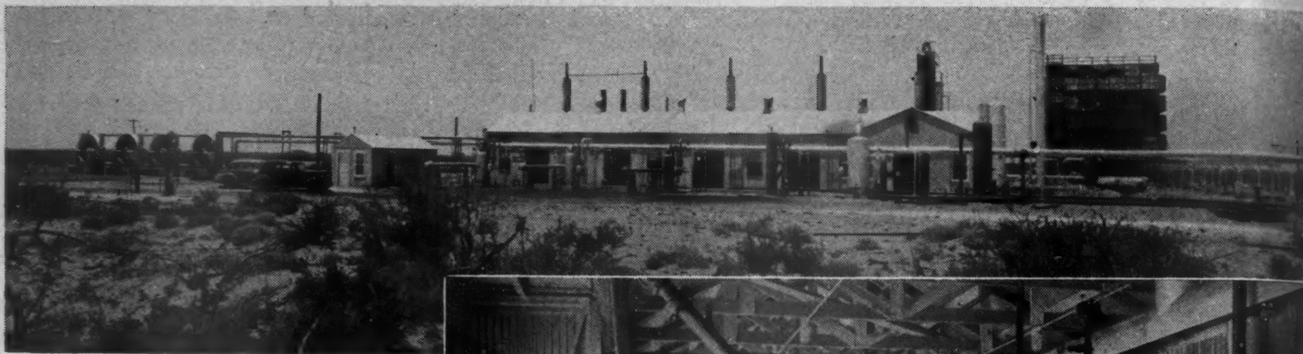
As steam replaced horse and mule power for drilling, and as churn drills gave way to rotary rigs, Spindletop No. 1 near Beaumont, Tex., prepared, at the turn of the century, to stage the spectacular opening of the true petroleum age. Old Spindletop—blowing tools and casing out of the hole on June 16, 1901, pouring a 6-inch stream of oil 160 feet into the air, and keeping 40 double teams busy building dikes to impound the 100,000 gallons discharged in each of the nine days before the well was controlled—was the sponsor of the stuttering adolescent engine, of the goggles and linen duster, and of the unresilient high-pressure tire always seeking some small obstruction on which to explode. The number of motor vehicles multiplied 300 times in the ensuing fifteen years.

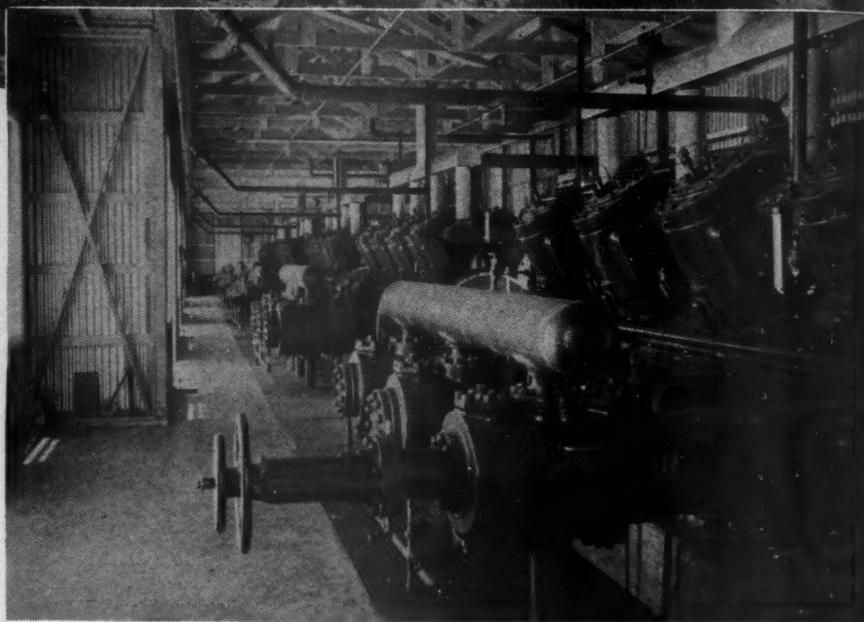
That one well was estimated to have produced one-sixth of the world's petro-



IN THE EMPIRE OF PETROLEUM

The four states of Texas, Louisiana, Oklahoma, and Mississippi accounted for 61.6 percent of last year's national production of 1,748,000,000 barrels of petroleum. Texas alone contributed 44 percent. Mississippi, a relative newcomer to the ranks, yielded 24 million barrels and is growing in importance, whereas Oklahoma is declining. Texas is so large that it offers almost every type of topography, some bleak and some verdant. The Panhandle (top-left) looks uninviting on the surface, but it harbors its quota of underground treasure. Most prolific of the Texas oil areas in recent years has been the East Texas Field. The view above shows one of its numerous small refineries. Gas that accompanies oil was formerly shamefully wasted, but much of it is now being compressed and sent underground to lift more oil to the surface. Before wells are put on gas lift, engineers run tests to enable them to design compressor plants to meet their needs. Portable compressors are ordinarily used for testing, and a Type XL unit in the Rodessa Field of Louisiana is pictured in the center. Another view in that vicinity (left) gives a close-up of the control valves on a high-pressure well. Because of its ornamentation, such an assembly is called a Christmas tree.





leum in 1901! Like its mother state of Texas, it was too vast for quick comprehension. In an effort to sell the accumulating lakes of oil, the owners communicated with a large eastern petroleum company, which dispatched a group of officers to Beaumont. The leader's comment on leaving was, "Too big, too big. There's more oil here than the whole world will need for the next century—not for us."

Many searchers for Jean Lafitte's hypothetical buried gold along the Gulf Coast had employed hypnotism and various forms of legerdemain, finally going modern and resorting to radio. A notice appearing in the New Orleans *Times Picayune* as late as 1930 (soon after an Acadian farmer had fired the zeal of treasure seekers by plowing up a pot of coins) claimed, "Buried treasure accurately located by radio. Reasonably priced, portable, and simple to operate. Free demonstration." Similarly, early oil prospectors depended upon willow wands, necromantic boxes, and, most frequently, hunches. While radio as a detector of buried gold has not proved to be all that was claimed for it, modern means of geologic exploration (some of which interpret the significance of seismic echoes far underground) have achieved a high degree of accuracy and have accounted in large measure for the discovery of as many as 50 pools in a 6-month period.

WEST TEXAS GAS-LIFT PLANT

Exterior and interior views of a compressor station near Wink, Tex. The machines are designated as 8-XVG units. Each has eight overhead power cylinders arranged, four on a side, in multiple V's. Horizontal compressor cylinders may be selected to give the pressures required to force gas into the ground.

Methods used in exploiting the early pools were as unscientific as those employed in finding them. When Spindletop blew in, Lucas, one of the owners, shouted, "Now that we've got her, boys, how are we going to close her up"? That was actually to be the dilemma of the southwestern oil industry for many years. Drilling of 500 wells on five acres of the amazing Spindletop salt dome, with derricks set so close that scaffolding was carried from derrick to derrick to provide escape for workmen should a well blow in or catch fire, typified the frenzied wastefulness of production.

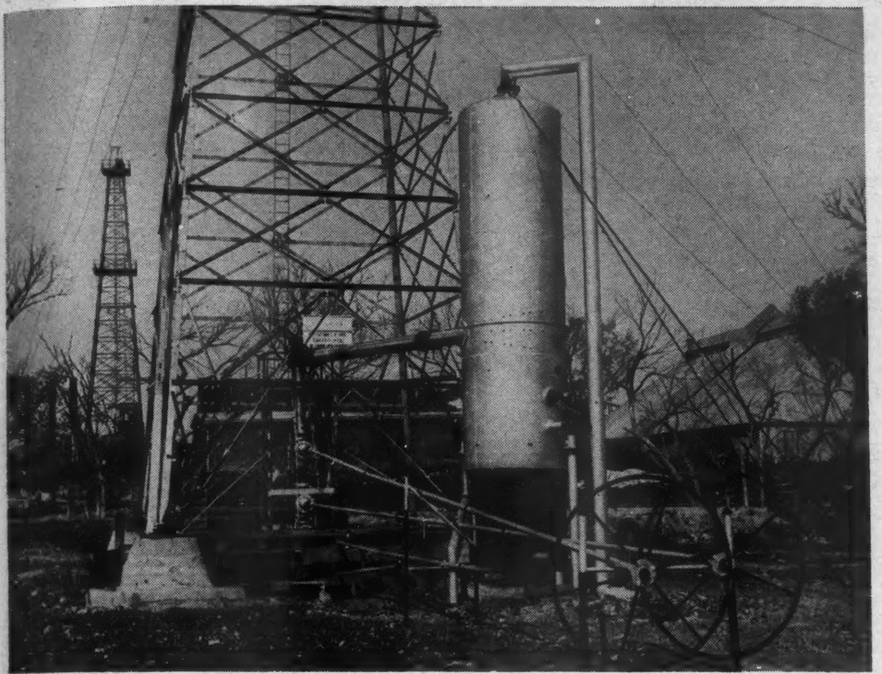
Early petroleum finance was as hysterical as production. Spindletop was the signal for the founding of 1578 companies in the country in one year, 122 of which found oil. Complexity of issues in hundreds of legal battles fought over oil has led to a unique development in administrative law; but the earliest concept of production was the "Rule of Capture"—the petroleum belonged to whoever took it from the ground. The prime objective was to get it out quickly from beneath one's own lease, and if some was drained from adjacent land in the process, that was no cause for concern.

If any moral implications apply to oil production, the spendthrift treatment of this great natural resource is perhaps no more deserving of censure than failure to practice selective logging and to protect second-growth timber in our forests. But continuing to operate on the principle of the mad scramble, with the price of crude rocketing wildly between such extremes as one cent and three dollars a barrel, proved poor business. The money wasted alone in drilling unnecessary wells in the East Texas Field has been variously estimated at 80 to 160 million dollars. It is believed by some that the great reservoir could have been effectually drained by less than 7000 wells, instead of by nearly four times that number.

Like gas in a soda siphon, gas pressure on an oil pool is the principal medium which induces free flow. Haphazard release of that pressure measurably shortens the period throughout which wells flow naturally, increases the viscosity of the petroleum, and adds to the difficulty of extraction. As a result, oil that would otherwise be recovered is left underground. On the Louisiana side of the great Rodessa Pool, gas is said to have been wasted at the rate of 600 million cubic feet daily, with an average per well of 10,000 feet for each barrel of crude.

In 1910, citizens of Bartlesville, Okla., grumbled because the roar of thousands of feet of escaping gas disturbed their sleep. It was estimated in 1913 that gas dissipated in the Mid-Continent Field was sufficient to supply Oklahoma for 60 years, and that the heating value of that wasted annually in the Cushing Pool was equivalent to five million tons of coal. Because gas burned in thousands of flares and rapid intrusion of salt water complicated work in many fields in the Southwest, operators recurrently faced overproduction as each new pool came in, trying meanwhile to evade the threats of scuttled prices and rigid Federal regulation.

In 1915 initial efforts were made at



HIGH-PRESSURE OIL WELL

This picture shows typical methods used in the 1930's for resisting high underground pressures in an Oklahoma field. Casing at the well head and the gas-oil separator in the foreground were tied down with guy ropes. Valves were remotely controlled by the hand wheels.

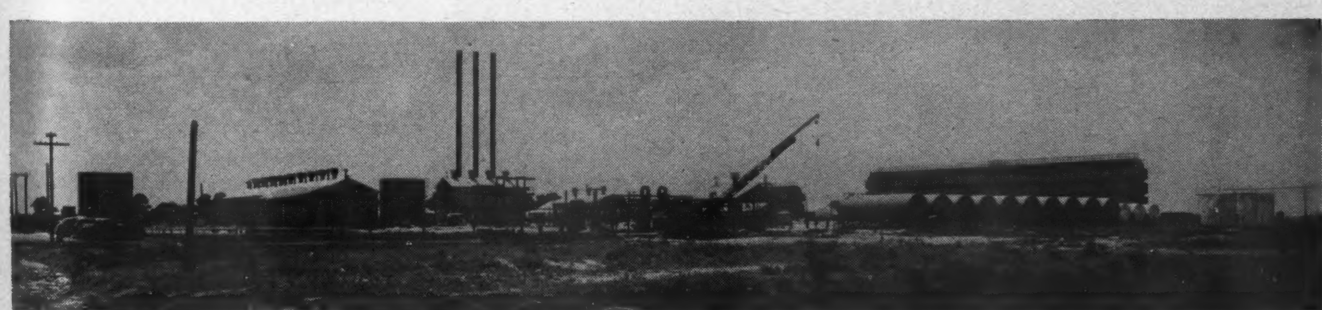
proration, but this proved a sort of hair shirt which had to be altered continually to fit each area. Typical of the problem of enforcement was the use of state militia by Governor "Alfalfa" Bill Murray of Oklahoma and the governor of Texas in attempts to close pools and stem the tide of "hot" oil during the depression of the "thirties." As recovery methods began to mature, and wasteful refining stills gave way to cracking and polymerization units, oil gradually influenced every phase of life in the Southwest, even politics and the size of churches and other public buildings. The industry has created its own lingo. We read of a gasser blowing in at Angelton at 8000 pounds, or the headline in a Fort Worth paper states, *Limestone to get wildcat to Smackover*, indicating that a well is to be drilled in an unproved area of Limestone County to an oil-bearing stratum named Smackover. The University of Texas is one of the country's wealthiest institutions of learning because of its own oil lands and bequests from oil-rich alumni. It is significant that all universities and many high schools in the Southwest offer courses in geology.

This fostering of public opinion as it relates to oil ties in with the fact that laws and regulations usually have little power unless the citizenry favor their enforcement. The Interstate Oil Compact Commission's edicts especially require this support. This organization represents an effort on the part of the principal oil-producing states to exert unified control over the industry to avert Federal regulation. Its action has been based on proration laws enacted by the several states and for which a test foundation was laid by the 1934 National Industrial Recovery Act. After the Supreme Court had nullified the latter in 1935, the Connally Act prohibited interstate shipment of petroleum that had not been obtained in accordance with proration. Early in 1935, representatives of the oil-producing states conferred in Dallas and made plans for an Interstate Oil Compact Commission. Congress formally approved it six months later.

Nighttime travelers in the oil country now see fewer of the great torches that waste heat, light, and thousands of horsepower. However, flares in several West Texas fields still burn more than 50 million cubic feet of gas daily, and the specter of government control has never loomed more ominously than now. Anticipated edicts of the Interstate Oil Compact Commission, expressed in rulings handed down by state regulatory commissions, will require fields still squandering large volumes of gas either to return it to the ground or to sell it to pipe-line companies for commercial use. While maintenance of gas pressure on an oil pool by artificial means is not economical under all conditions, it is the method most generally practiced, and resultant over-all savings and total recovery often far exceed operators' expectations. Gas compressors powered by internal-combustion engines using natural gas as fuel are used for the purpose. They have been developed to a high degree of efficiency and, what is equally important, reliability.

Under ideal conditions, artificial maintenance of pressure on a pool would be planned, if not indeed applied, as soon as an area had been proved and brought in. General practice to date has been to initiate a program of pressure maintenance only after wells have ceased to flow naturally. But by that time producing formations, more often than not, have become almost uncharted areas through the use of explosives and the acid treatment, with no reliable data available on wells and strata penetrated.

The large Fullerton Field in west Texas is an interesting example of industrial relations and coördinated planning. Some 23 companies operate leases there, with 383 wells producing at depths of 7500 to 8500 feet from the Clearfork



"NATURAL-GASOLINE" PLANT

Some natural gas is rich in liquid hydrocarbons from which "natural gasoline" can be extracted. The conventional method of doing this makes use of thousands of horsepower of compressors. Here is shown a large extraction plant that was built for the purpose. It is located near Houston, Tex.

and Fullerton pays. Exploitation began recently enough so that spacing of wells was governed by proration standards. Production staffs have collaborated in retaining cores and filing data on all wells drilled, and a unitized compressor plant is being planned for pressure maintenance on the entire field. This will involve compressing some 150 million cubic feet of gas to 2500 pounds pressure daily and distributing it to suitably located injection wells. Around 30,000 hp. will be required for this work.

The gas-oil ratio of 2500 cubic feet of gas per barrel of oil was originally enforced in 1940 and initiated the installation of many thousands of horsepower in compressor stations. This was supplemented on many leases by immediate orders to shut down some of the leaner wells unless means could be found to improve the gas-oil ratio. The earliest applications of artificial pressure to accelerate or restore the oil flow were based on the simple air-lift principle long used in water wells. This method was introduced in the great Seminole Field of Oklahoma when flush production began to wane and before proration allowables and the yardstick of gas-oil ratio had begun to govern. Compressor plants were set up as free flow fell off, and gas at 300 to 500 pounds pressure was forced down the casing to raise large volumes of oil through the inside tubing. With the advent of rulings to effect conservation, the daily allowable for each lease became too small to permit the employment of this type of lift, and two kinds of flow valves came into general use for the pressure lifting of small volumes: the intermitter valve, which admits high pressure gas to the tubing in timed cycles, and the autovalve, which feeds gas to the tubing when the column of oil inside of it and above the valve reaches a predetermined weight.

Many examples may be cited of both large and small compressor plants to maintain production. Typical is the experience of the Monday Oil Company, which operates a quarter-section lease with sixteen active wells in the Kermit Field of west Texas. In 1940 its allowable was reduced some 50 percent because of excessive gas-oil ratio. A 300-hp. XVG gas engine-driven compressor was installed for pressure maintenance on the producing formation and for gas lift. This unit has eight cylinders arranged in two 60° V-banks, with each pair of power connecting rods articulated to a master rod which drives a piston in one of the four horizontal compressor cylinders. Compression ratios and multistaging are arranged to produce desired gas pressures. Use of the 4-cycle principle in engine operation assures the smoothness and flexibility and the low up-keep so essential to oil-field service.

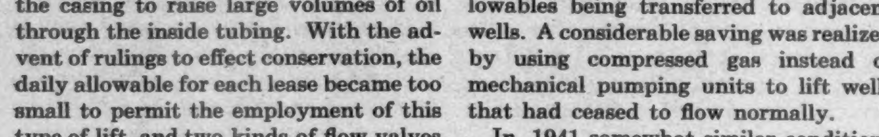
Enough gas was returned to the oil horizon by this one compressor so that the over-all net gas-oil ratio became less than the requisite 2500 cubic feet per barrel, thereby again giving the lease the maximum allowable per well for the field. Four wells were employed as injection or key wells, their production allowables being transferred to adjacent wells. A considerable saving was realized by using compressed gas instead of mechanical pumping units to lift wells that had ceased to flow normally.

In 1941 somewhat similar conditions induced the States Oil Company, working the Strawn Sand near Abilene, Tex., to install two 300-hp., 3-stage XVG compressors. Three years later, as the field expanded, a third unit of the same size was set up. These machines take gas from the gas-oil separators at 10 pounds and deliver it at 1250 pounds to five suitably located key wells. During the five years of pressure maintenance the injection pressure has declined to some 900 pounds per square inch. The productive life of the pool and oil recovery have been increased manifold. An interesting feature of the compressor plant is that the gas handled is very wet—heavily charged with natural gasoline—so that a substantial volume of condensate is recovered as drip from the compressor intercoolers. This by-product is stored and gauged separately, thereby permitting it to be sold in addition to the crude oil allowable for the lease. Sufficient revenue has thus been obtained to more than cover the cost of operating the compressor plant.

The famed Permian Basin—the bed of an ancient inland sea, 800 miles long and 300 wide, extending from the Rio Grande to the Mississippi—includes the great Gulf Coast oil pools to form the richest proved petroleum reserve on the continent. On the western margin of this area, C. V. Lyman, an operator of several leases in the Hendricks and Old Wink fields, has engaged in the unusual enterprise of marketing compressed gas as an oil-recovery agent to several neighboring operators. This came about because Mr. Lyman had several dry-gas wells the output of which could be piped to producing areas and employed to raise oil in wells whose pressures were inadequate or had declined in the course of production. In this instance, the naturally pressured gas might have been sold for doing mechanical work. But drawing it off the separators and burning it in flares after lifting his clients' crude, thus giving it a clean bill so far as proration was concerned, did not obscure the fact that that constituted a depletion of underground pressure and that the gas might have been salvaged by repressuring and kept working.

In 1944, Mr. Lyman's installation of two 2-stage XVG compressors enabled him to shut in his gas wells to await a more lucrative market and largely to utilize repressured gas for producing his own and his neighbors' oil. The relatively short life of some pools in certain areas has encouraged the use of unitized plants of semiportable XVG compressors which can be relocated at strategic points to reduce piping requirements. Mr. Lyman's diversified activities have expanded until he now has 1800 hp. busy repressuring gas for "pumping" oil by gas lift. He has built an absorption plant to recover natural gasoline, and he sells some gas to a pipe line for commercial use.

Oilmen realize that natural gas is not a necessary evil that comes along with oil, but that it is an indispensable source of energy in the process of production and a salable commodity.



PACKAGED COMPRESSORS

Two self-contained semiportable Type XVG compressors just after they were unloaded from trucks. Units such as these are coming into favor because they can be started in a matter of hours, moved quickly when desired, and are an economical means of handling gas that was formerly burned in flares. The gas may be put into commercial pipe lines for marketing, injected into the ground for lifting oil to the surface, or otherwise put to profitable use.

This and That

Electric Tree Feller

A General Electric Company engineer, H. W. Bousman, put his knowledge of electricity to work in trimming and cutting down trees at his home in Scotia, N. Y. Around a tree that he desired to fell he placed a loop of wire made of Nichrome, a nickel-bearing metal that retains its strength when red hot. To the loop he connected an electric line, first passing the current through a transformer to obtain high amperage at low voltage. Weights were applied to the loop in such a way as to pull it through the wood as it slowly burned a path. Large limbs were lopped off trees in like manner. In the wintertime Bousman strings his wire along the base of his garage doors. When a freeze comes and the doors tend to stick, all he has to do is to turn on the current and the ice soon thaws.

* * *

German Safety Practices

American investigators for the Office of Technical Services found that safety education was highly developed in German industrial plants. The German system emphasizes protection of machines rather than of individuals, but workers are given detailed instructions in accident prevention. Apprentices are even given lessons in floor sweeping. After such thorough training they are well aware of the precautions that should be taken and, consequently, do not require as much safety supervision as American workers. Most plants make their own guards for machinery, and these naturally vary in design and efficiency. The law requires special guards for all grinding wheels. Industrial gas masks embody apparatus for producing oxygen from peroxides, and the investigators suggest that it might profit us to adopt it and thereby reduce the bulk and complexity of mine-rescue equipment used in this country. The Germans likewise developed a method for quickly measuring the amount of oxygen in air, as well as a simple means of detecting the presence of flammable gases.

* * *

Rebuilding Blitzed London

Changes of great magnitude in underground London will no doubt be made during the rebuilding of the city's war-damaged areas. Some railway terminals will probably be moved underground, in one instance as much as 120 feet below street level. The plan envisages excavating tunnels for main-line trains that will require three million tons of iron castings to line them. Burrowing will involve the removal of enough earth to make a 50-foot pile on an area a mile square. One of the problems will be the disposal of this material, as nearby pits and dumping sites have been filled to overflowing with the rubble from bombed structures. In all likelihood it will be transported to places in the Thames Valley, 20 miles from the city, where gravel dredging has left huge depressions.

* * *

Highway Weight Figures

The American Roadbuilders' Association reports that 1480 railroad cars are required to transport the materials used to build 10 miles of concrete highway. Once the road is in place, however, it can reasonably be expected to last 30 years, and during that period it will carry many times its own weight. A 10-mile stretch entering Washington, D.C., is cited as an example. It is estimated that in three decades it will be traveled by 20 million people in 9,307,500 passenger cars and 1,642,500 trucks and buses. Over it in the same period will move 1,520,000 tons of milk and 1,297,000 tons of citrus fruits, to say nothing of enormous quantities of other foodstuffs and merchandise of all kinds.

* * *

Tires Going Rural

The Goodyear Tire & Rubber Company estimates that motorized equipment on farms is now almost 99 percent "rubberized." This movement was accelerated during the war, and production of farm tires was 50 percent greater last year than in 1941. "If tractors and other farm machinery had not been rubberized," a company statement says, "America and the rest of the world would have been much worse off than they were in the matter of having enough food to eat. Faster, lighter equipment made possible by rubber tires enabled the nation's farmers to harvest much more than would have been possible if they had used steel tires." This trend towards rubber tires indicates a large and growing field for manufacturers of air compressors. Pumping up a big tractor tire with a hand pump is arduous and slow work, and many farmers are buying compressors for this service. This is naturally turning inventive minds towards the development of additional rural compressed-air uses that will enable farmers to get more service from their compressors and further justify purchasing them. Pneumatic labor-saving aids are common in every branch of the manufacturing and processing industries, and are increasing year by year. It is reasonable to assume that human ingenuity can and will similarly adapt equipment to simplify work in the field of agriculture.

"Brother, if I get lost in there I want to be easy to find."

* * *

Mobile Mining Plant

To expedite the wartime search for strategic metals, the Nova Scotia Department of Mines designed a complete small diesel engine-driven mining plant on wheels that could be moved quickly from place to place to make preliminary investigations of surface mineral showings. The outfit includes equipment for drilling, hoisting, ventilating, crushing, and screening, together with blacksmith and repair shops and portable dwellings for the crew. All are mounted on trucks and trailers and, as new mineral discoveries are seldom found near good roads, a tractor with a bulldozer and grader is included. The outfit proved to be so effective that its service is being continued to promote the department's peacetime activities.

* * *

Butte's Probable Future

Anent the manpower problem in metal mines, the situation at Butte, Mont., is of interest. During the war years, Butte was a busy place, but not so busy as it would have been had more miners been available. The camp ordinarily produces a lot of zinc, but its zinc mines were closed when the Government asked that all efforts be concentrated on getting out copper and manganese. Butte's population was materially less in World War II than in World War I. The minerals were there, but the miners were not.

With the end of the war and the dis-

charge of former miners from the armed services, the situation did not improve much. An official of the Anaconda Copper Mining Company stated last summer that "Things would be good in Butte if we could get a few thousand more men." Since then there has been considerable betterment, but there is still a pronounced shortage. Current conditions and the future outlook were reviewed last month in an informal talk by D. M. Kelly, recently retired vice-president who is now an Anaconda administrative consultant.

Mr. Kelly stated that 783 more man-shifts per day were being worked "on the hill" in January than in July of last year, but even with that increase only copper and manganese were being produced. The company is preparing to resume zinc mining, and some men have been hired for that purpose at the Anselmo Mine. Capacity output at that one

"Could you cream this, or something? I lost another bet on when we'd hole through."

property will require the services of 500 men. Mr. Kelly indicated that, all told, Butte still lacks about 2500. That the shortage cannot be attributed to poor pay was made evident by figures the speaker cited. The average Butte miner who works for wages makes $10.32 a day, the equivalent of $61.92 for a 6-day week. Those who work under contract average $12.57 daily, and some receive from $15 to $20.

Of incidental interest was the statement that 9,500,000 tons of old copper mine dumps and tailing piles were milled during the war. They had a copper content ranging from 0.7 to 1.5 percent, most of which was reclaimed. In addition, they yielded 5,500,000 ounces of silver and 17,000 ounces of gold. Old zinc dumps are now being shipped at the rate of 1500 tons of material daily. With regard to the future of Butte, Mr. Kelly stated that methods are being developed by the company's engineers and production men for mining pillars of low-grade copper ore that were left in place in the mines in bygone years. These are estimated to contain two billion pounds of recoverable metal. All in all, it is safe to say that there is more known metal in Butte hill now than at any time since it was discovered.

★ ★ ★

Tin Cans And Other Containers

Not many years ago nearly all small containers were tin cans, but times have changed. The American Can Company, largest concern in the field, now makes 2000 kinds from metal, fiber, and various combinations of the two. It employs 280 persons in research work aimed at improving the containers now in use and developing new ones. It inaugurated its research program 41 years ago, and its principal laboratory at Maywood, Ill., has 81,000 feet of floor space. One of the chief lines of current investigation has for its purpose the production of low-cost cans that will still be safe for packaging processed foods.

★ ★ ★

Bark Stripper Saves

A process was devised a few years ago for descaling freshly rolled steel strip with high-velocity water jets, and it is now in fairly general use. The necessary pressure is developed by centrifugal pumps working in conjunction with air-actuated accumulators. Later, the same idea was applied to the debarking of logs for paper making. The first hydraulic bark-stripping plant to be installed in Canada has recently been put in operation by the Powell River Company in British Columbia. The equipment handles logs ranging in diameters from 5 inches to 6 feet. The advantage of the method is that it strips the bark off clean without removing any of the pulpwood that is normally lost. In this instance, it is estimated that the debarker will save enough pulpwood in 1947 to manufacture paper for all of British Columbia's newspapers for the next two years.

★ ★ ★

Fish From Afar

A commercial fishing industry has been established at Great Slave Lake, Canada, hundreds of miles from the nearest thickly populated area. The Dominion Government, which regulates all Canadian fisheries, made investigations several years ago that showed that the lake, fifth largest in North America, contains large stocks of trout and whitefish and could safely supply several million pounds annually. One company sent men and mechanical freezing equipment

"At least I feel that I'm properly dressed for this job."

there in 1945 and harvested 1,500,000 pounds of fish in a few weeks. It was frozen and transported in barges down the Athabaska River system to Waterways, Alta. Fishing was continued last summer and plans were made for future wintertime operations. Southwest of Great Slave Lake are two other bodies of water—lakes Tathlina and Kakisa—that have a combined area of 1000 square miles and can be reached by rail and roadway. These, too, are being investigated, and the indications are that they will be the scene of commercial fishing before long.

★ ★ ★

Better Aircraft Tires

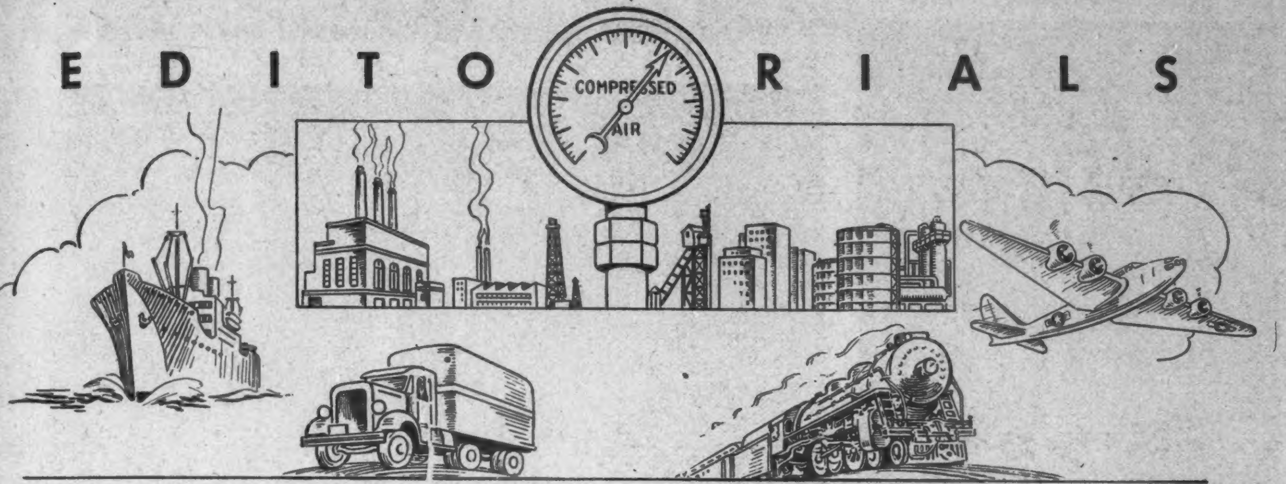
The United States Rubber Company has developed a wire-reinforced airplane tire that is designed to carry a load of 20 tons. It weighs 320 pounds and is smaller than previous tires of the same type to permit its retraction into superspeed planes having relatively thin airfoils. The tire normally carries 250 pounds pressure, but has a bursting point of around 1700 pounds.

★ ★ ★

Testing Bridge Model

As a preliminary to designing a 3000-foot suspension bridge over the River Severn in England, the National Physical Laboratory will conduct special model tests to aid in computing safe wind stresses for the new structure. A wind tunnel capable of housing a model 52 feet long is being constructed for the purpose. Although longer bridges than the one proposed have been built in America, the English designers are leaving nothing to chance. They are bearing in mind the failure of the old Tay Bridge in 1879 and the collapse in 1940 of the Tacoma Narrows span, which was called "Galloping Gertie" because it vibrated noticeably in a wind.

EDITORIALS



SCHOOLS FOR MINERS

ON SEVERAL occasions we have commented in these pages on the serious shortage of metal miners that has adversely affected the output of our mines and that has even kept some of the gold producers from reopening after the war-enforced shutdown. It is not a local problem, or even a national one, for it exists in Canada and South Africa as well as in the United States. In some sections there is a shortage of all kinds of labor, in others only of miners. The iron mines in northern New Jersey are situated practically next door to the biggest labor market in the country. More than ten million people live within easy traveling distance of them, and still they can't recruit enough men for underground work. In Canada, miners are better paid than any other class of industrial workers, yet there are far fewer applicants than there are jobs. In view of these facts it can be concluded that men shy away from mining for one reason or another.

A writer in *Canadian Mining Journal* believes he has put his finger on the chief difficulty. He says the mines have been sending new employees underground without sufficient training, or even without any training. Most of them have little conception of their duties, are unfamiliar with the machinery and equipment, and naturally commit many blunders. Under these conditions they soon become discouraged and quit, sometimes in a week or two and often in a day or two. Lots of times the experienced miners aren't very coöperative.

As a corrective measure, this writer advocates that mines set up schools of instruction and that newly hired men spend their first few shifts in them at full pay. There they would be told something about the equipment and the general scheme of mining followed, and when ready to go underground they wouldn't feel lost and bewildered. Motion pictures could be utilized to good advantage. From them the newcomers could learn how to set up a rock drill, how to pull a chute, and how to load blast holes. After a few days they would be sent below and there given practical training under the guidance of competent teachers.

At the Sunshine Mine, in the Coeur d'Alene District of Idaho, something akin to this plan is actually in force. Surface instruction is not emphasized, but inexperienced men are assigned to a "student stope" in the mine. There, under the tutelage of a shift boss and experienced miners, they learn the rudiments of underground work. After a training period, the length of which depends upon aptitude, the novice is able to do things pretty much on his own. He acquires an interest in the work, gains confidence in himself, and makes a satisfied, worthwhile employee.

The plan has not been in operation long enough for the Sunshine management to make a public declaration regarding its efficiency. However, it is significant that the mine's daily production was recently increased to 500 tons, whereas it had been running along for many months at 300 tons.

GASIFICATION OF COAL

COAL is still king of fuels and is likely to remain so for many years, but there may be some changes in the manner of its utilization. Atomic power is as yet only a scientific toy. Ways of putting it to work must still be devised and then reduced to a competitive cost basis. Petroleum and natural gas are preferred fuels, but known reserves are far less than those of coal. Prevailing methods of burning coal waste a lot of the contained heat value. Moreover, it is expensive to mine coal, the work is uninviting, and men are becoming increasingly reluctant to do it. When coal is heated it gives off gas, and the gas burns in combination with air. If coal could be made to give up its gas underground, we could have a clean fuel without the necessity of digging it. This is not a new idea.

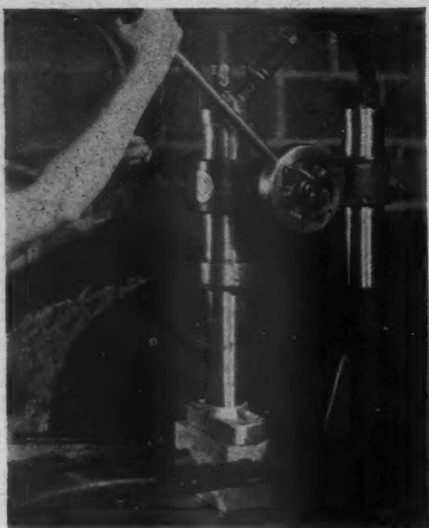
The Russian chemist Dmitri Mendeleyeev predicted more than 50 years ago that there would come a time "when coal will no longer be dug out of the ground and when we shall convert it directly into gas, which will be piped long distances to factories and homes." Other scientists later approved the idea, and some experiments were made in this country; but the first commercial-scale plants were put up by the Russians just prior to World War II. Three were operated until they were overrun by the Germans, and two were under construction.

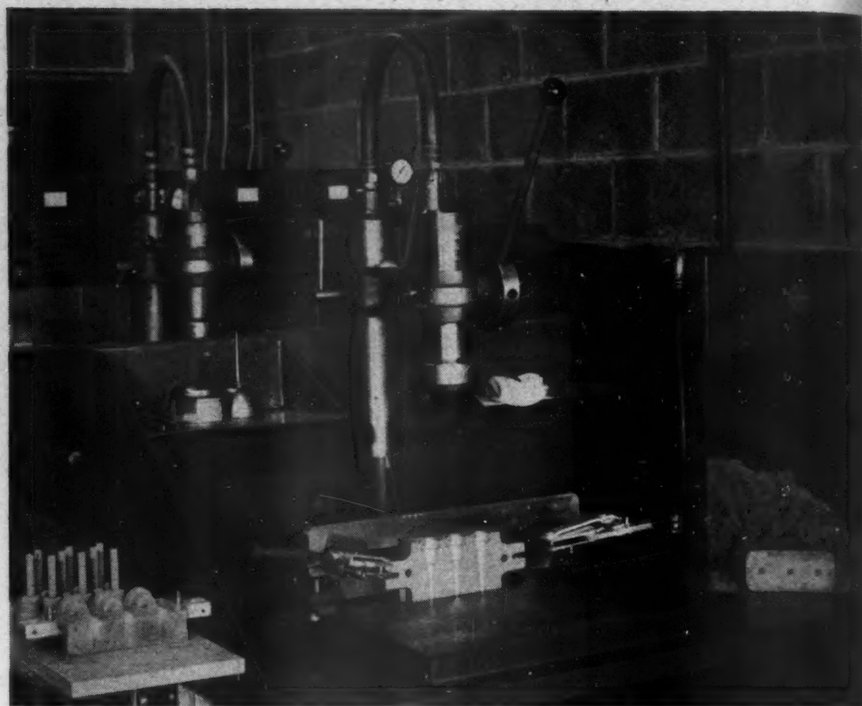
The Gorloff Station alone yielded 2650 million cubic feet of gas. Some of these establishments are known to be in service again, but little information is available about them. The Russians found that the heating value of the gas could be more than doubled by using oxygen to enrich the air forced through a burning coal bed. Recently developed processes for producing oxygen at low cost are therefore important.

The first extensive experiment with underground coal gasification in this country is now in progress in Alabama, where the Alabama Power Company has isolated a part of its Gorgas Mines for the purpose. A passage was driven down into a coal vein, along the latter, and back to the surface. The coal was ignited with an incendiary bomb, and a 10,000-cfm. blower is forcing air down one leg of the U-shaped duct into the fire zone to provide oxygen for combustion. The gas is collected as it emerges at the opposite end. Various instruments have been placed at strategic points to obtain pertinent information, and observation posts enable men to see how the fire burns, any caving that may occur, etc.

The Alabama Power Company now burns coal from the Gorgas Mines to raise steam for generating electricity. It is interested in finding out if gas produced in the mine will do the job at less expense. The experiments are being watched by government scientists and technologists from various industries, many of whom are on the scene.

Quick-Action Pneumatic Core Blower





HOW CORE BLOWER WORKS

In the picture above, the machine is shown with a vertically split core box clamped in blowing position. Down pressure on the near handle effects an airtight seal between the sand cartridge and the blowing cylinder, while the lever in the rear admits compressed air that blows the sand into the box through matching blowholes in the latter and in the base of the cartridge. Vents in the core box permit the escape of the air after it has done its work. At the right is another view of the sand blower with the clamps open and cartridge removed. The latter has been shoved into the sand pile (right) for refilling and shows the blowholes in the base. The stripped half of a core box is seen resting against the back plate of the clamping fixture; the other half with the cores still in place stands on the table at the left.

AMONG the equipment that has been designed to facilitate the work of the foundryman is an improved Redford sand blower for making small, intricate cores, those separate parts of a mold that shape the interiors of hollow castings. The unit is of the bench type and fills the core boxes through the medium of a cartridge from which the sand is ejected by compressed air. The cartridge consists of a seamless-steel tube that is pressed into an aluminum base into which are drilled as many holes as there are blowholes in the core box. The number of these determines the size of the base, and the height of the cylinder depends upon the amount of sand required to make a core. The cartridge is loaded after each operation.

Surmounting the cartridge is a blowing cylinder, which is supported through the medium of an arm by an upright column that also serves as an air reservoir and triples the air supply available for each charge. At the base of the column is a hose connection for a blow gun, the purpose of which is to discharge from the reservoir any condensate that may collect there and thus insure dry air for core blowing. There is an air gauge at the top of the column, and this enables the operator to check the line pressure at all times.

Air consumption is low, approximately ½ cubic foot per core, and air at from 85 to 125 psi. is adequate to make cores in single or gang boxes requiring a maximum of 2 pounds of sand. The air supply may be taken from a shop line, or a compressor may be installed, a 3-hp. motor-driven unit being sufficient to meet the needs of six machines in some foundries. Supplemental fixtures include adjustable clamps to hold vertically split core boxes while blowing is in progress, and for the cores that are hard to draw or remove from the boxes there is a vibrator. This unit is controlled by an electric or pneumatic knee valve and is attached to the back plate of the clamping device, thus permitting the operator to blow a core and draw the box at the same station. The clamping attachment is held in place by lock nuts on each side and is readily adjustable to take core boxes of varying dimensions. Cartridges are available in nine standard sizes, and special ones are made to order. However, each may be used with different core boxes of approximately the same dimensions.

Plant Scrubs Fractionators with Air and Water

FRACTIONATING towers used in the production of high-octane gasoline by the catalytic-cracking process are being cleaned by a new method at the Latonia Refinery of the Sohio Petroleum Company. The system is said to be effective for towers containing catalytic material, carried over from the reactors, and charcoal, and supplements the customary steaming and flushing.

Following purging, the water level in a fractionator is dropped below the top manhead, which is then opened so that dirt can be washed out without fouling the condensing system. Next, compressed air and water are simultaneously admitted at the base of the tower, the former through a gauge or sight-glass connection. The air is turned off after a lapse of several minutes, while the water continues to flow uninterruptedly. After a few more minutes the air is turned on again, and this goes on until the water coming out of the fractionator shows little trace of dirt.

The effect of the air-and-water scrubbing treatment has been described by the company's process superintendent as follows: When the air enters the tower it pushes the water through the trays at relatively high velocity and very high turbulence. As a result, considerable quantities of scale and foreign matter are loosened and carried out of the fractionator by the water. Although the system does not remove all dirt, it gets rid of enough so that other cleaning operations are reduced to a minimum. The method was developed by John Weghorn, stillman at the catalytic-polymerization plant of the Latonia Refinery.

Industrial Notes

An upholstery cleaner for automobiles has been invented that is said to have six times the vacuum power of most motor-driven machines used for the purpose. The equipment is operated by an air compressor and is to go into production shortly.

Aluminum Solder Corporation has acquired the North and South American rights for the manufacture and distribution of an aluminum solder for joining sheets, electric wires, and other aluminum products. The solder is of Swiss origin and is marketed under the name of Prolyt. It is said to require no flux or flux substitute.

Built on a miniature scale for use in connection with instrument air-supply lines, the Moore Products Company dripwell air filter is said to be an effective oil and water remover or fog preventer. Entering at the top, the air passes down through the filtering medium in an open-end cylinder and up between the latter and the housing, both of which are of brass. Oil and moisture are trapped in a bottom chamber and blown off intermittently. Unit is 9 inches long and 2½ inches in diameter.

Among the new products announced lately is a self-sealing plug for closing openings in tanks, boilers, and other vessels that have to be tested internally by hydrostatic or pneumatic pressure. The plug is being manufactured by the Mechanical Products Corporation and is said to offer a speedy and effective seal,

SECTIONAL VIEW
Plug applied to tank opening showing tight seal of tapered pull-rod head.

especially against high pressures. According to the company, insertion or removal takes but a second or two because pressure with the thumb on the latch lever closes the opening, and down pressure on the plug itself again engages the latch, permitting withdrawal. Losses such as are frequently experienced when removing screw plugs that have become frozen in place are eliminated, and design takes advantage of the pressure within the tank to hold the seal against its seat. Known as Hydro-Matic, it can be adapted for use with any type of spudded, flanged, or drawn opening, either threaded or plain, and is carried in stock for standard pipe ½ to 2 inches in size and for test pressures up to 500 pounds per square inch. Special plugs are made to order.

Among the features claimed for a new flashlight are watertightness and a long reach that permit it to illuminate submerged and inaccessible areas. Instead of the conventional bulb assembly in the head of the case, the lamp retainer is at the end of a long flexible-tube extension. There are two models, 15 and 16½ inches long over-all, respectively. The latter size, or Master, has two regular flashlight batteries and a sliding switch; the Junior, with a pocket clip and a thumb-type switch, contains two standard AA Penlite batteries. Both have aluminum cases and are made by Aero-Motive Manufacturing Company under the name of Flex-Lite.

Rotary broaches are a new means of cutting holes in metals with such accuracy, it is claimed, that the usual finishing operation is often unnecessary. The tool is known as Shearcutter and has high spiral or helical cutting edges that remove metal in true shearing fashion when pressure is applied at the shank end. Cuttings produced are not the customary chips but are akin to steel wool in form and texture. According to the manufacturer, the Fearless Tool

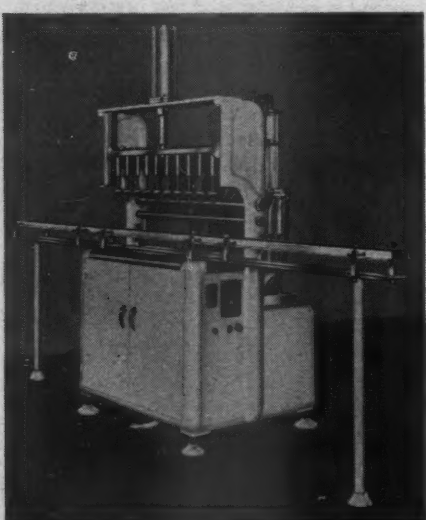
MORE, BIGGER, AND BETTER PNEUMATIC TIRES

The nation's rubber industry produced 87,360,000 pneumatic tires in 1946, or one-third more than in 1941, the last prewar year. The 1946 output was divided as follows: passenger-car tires, 66,500,000; truck-bus tires, 15,800,000; farm-equipment tires, 4,800,000; airplane tires, 260,000. Current production is at the rate of nearly 100 million annually, an all-time peak, but is due to slacken because the demand for replacement tires built up during the war is now fast being satisfied. The Goodyear Tire & Rubber Company recently turned out its 400 millionth tire, which is pictured here with, left to right, R. P. Dinsmore, vice-president in charge of research; P. W. Litchfield, chairman of the board; and E. J. Thomas, president. During its 41 years of tire-making the company has consumed 1½ billion tons of rubber. Goodyear is now manufacturing a 30-ply tire for earth-moving machinery that weighs 2085 pounds, stands about 8 feet high, and has a cross-sectional width of 33 inches. After it is built, it has to be vulcanized in a mold, the bottom half of which is shown with W. E. Shively, manager of tire design.

Company, the broaches can be sharpened from 10 to 30 times before the diameter is reduced. They are available with straight shanks only and in sizes from 1/4 to 1 inch and from 1 1/8 to 1 1/2 inches in 1/16 and 1/8-inch intervals, respectively. Larger ones are made to order.

Ball bearings from a porcelain factory. Sounds strange, but a recent news report from Germany says it is correct. The bearings have a ceramic core covered with a thin metal shell and are being manufactured at Hersdorf. They are claimed to be almost equal to the familiar steel ball bearings in wearing quality. No doubt they were developed as a substitute for the latter, because Germany's ball-bearing works were one of the main objectives of Allied bombers.

Vacuum and compressed air are used by the Ertel Engineering Corporation to operate its new bottle-filling machine that may be utilized in connection with a conveyor system. Filling is done by vacuum pumps that draw the liquid from a built-in reservoir fed by gravity and deliver it to multiple spouts on a rack mounted on top of the cabinet housing the vacuum pumps, selector valves, and motors. Surmounting the



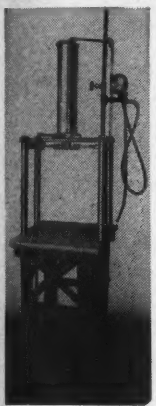
rack is a foot-controlled air cylinder that raises and lowers it and permits handling bottles from 3 to 13 inches in height. Adjustment for bottle diameter is made by changing the spacing of the spouts. The latter are of the dripless type. Speed of filling varies with the operator, but is said to average 50 quarts a minute, or more or less in accordance with the size or capacity of the containers.

A paint remover in liquid form for horizontal surfaces and of a creamlike consistency for vertical and exterior surfaces is offered by Gillespie Varnish Company. It contains a quick-acting solvent that is effective against heavy

coatings of old paint, enamel, varnish, shellac, and lacquer and is said to remain moist and deep-cutting for as long as 24 hours even in a hot sun. Coats are reduced to a soft sludge that can be stripped without leaving a greasy film. Product is known as Bull Dog and is available in varying quantities.

Patchmaster is the designation of a new clamp designed by Marman Products Company to stop leaks in low- and high-pressure pipes ranging from ½ inch to 4 inches in diameter. Made up of a stainless-steel clamp, patch plate, and Hycar oil-resistant pad, device conforms to the contour of the pipe and is said to provide a positive seal. Patches have withstood test pressures of 800 pounds per square inch, says the manufacturer.

For molding, drawing, swaging, and forming thermoplastic sheet materials ranging from thin acetate to heavy acrylic sheeting, Indiana Foundry, Machine & Supply Company has produced a pneumatic press of simple design. There are two models—Nos. 420 and 624—both of which are operated by a double-acting air cylinder controlled by a foot valve. The first is a quick-acting unit for use with multicavity molds and dies drawing sheet material of moderate area; the other is slower acting and is equipped to form or draw larger sheet areas by means of bigger dies. Cylinder piston, together with male die plunger attached to it, is guided by posts to keep it in true vertical alignment and develops a normal pressure of ½ and 1 ton, respectively, using air at 75 to 100 pounds pressure. Standard equipment includes a pressure regulator and gauge and a lubricator. An air filter such as an Aridifier is supplied upon request.



Flood lighting for construction and other outdoor jobs remote from electric lines is faciliated by a self-contained unit mounted on two wheels for towing and provided with four lights on steel standards, one at each corner. The completely housed power plant consists of an air-cooled 4-cycle gasoline engine, of a 3000-watt alternating-current generator, and of two heavy-duty starting batteries with push-button control. The floodlights, each of 750 watts, can be raised to a maximum height of 7 feet and swung horizontally through an arc of 360°. Provision is made for operating auxiliary lights or power tools. The portable is made by D. W. Onan & Sons, Inc., and is named Onan Floodlighter.

Industrial Literature

A 40-page booklet giving technical and application data about 36 grades of insulating varnishes has been issued by the Resin and Insulation Materials Division, Chemical Department, General Electric Company, Pittsfield, Mass.

Rubber gloves for industrial service that resist oils, acids, and grease are covered in a new catalogue section published by The B. F. Goodrich Company, Akron, Ohio. A page of illustrations suggests ways of getting maximum wear from gloves of this type.

Foundry Mechanization presents the complete line of Allis-Chalmers Manufacturing Company's equipment for the foundry, including a new portable shake-out unit and a sand scrubber for use with a wet reclamation system. The publication, No. 07B6092A, may be obtained from the company at Milwaukee 1, Wis.

To meet the need for technical information on the fabricating and processing of aluminum, Reynolds Metals Company has inaugurated a new publication, *Technical Advisor*, that will be issued periodically. Copies may be had from the company's Technical Editorial Service, 2500 South Third Street, Louisville 1, Ky.

The Falk Corporation, Milwaukee 8, Wis., has produced a 32-page multicolored bulletin, No. 4100, describing its line of Steelflex couplings that are used to connect various types of industrial machinery to their driving motors or engines. The publication includes selection tables and engineering data.

Hewitt Rubber, 240 Kensington Avenue, Buffalo 5, N. Y., has issued a folder describing its Monarch brand of transmission belting which is designed for heavy-duty service in pulp and paper mills, stone-crushing plants, mines, quarries, foundries, saw mills, and other industries.

The Util-a-tool is designed to perform such operations as moving machinery, straightening structural frames, pulling in bulged car and truck sides, lifting and lowering heavy machines or objects during dismantling or assembly, and pulling wheels, gears, pinions, and bushings. It is described in Bulletin P & P 46, available from Templeton, Kenly & Company, 1020 S. Central Avenue, Chicago 44, Ill.

Air-driven tools are especially welcomed by contractors because they invariably have a source of compressed air for operating them. It is not surprising then that new or improved pneumatic mechanisms are continually being produced for the contracting field. A 24-page, 2-color bulletin, titled *Air Tools for Contractors*—Form 5600—is obtainable from Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y. It illustrates and describes in detail the varied line of I-R equipment suitable for the construction industry.

Called an "electronic brain" by its manufacturer, the Motron is a small system that can be applied to the automatic control or regulation of a large variety of industrial operations to eliminate the need of human supervision. Among suggested uses is that of regulating the velocity of air streams in such applications as separating chaff from field-grown food products, sizing coal and other granular materials, etc. Bulletin H-26, which describes this device, can be obtained from the W. C. Robinette Company, 802 Fair Oaks Avenue, South Pasadena, Calif.

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